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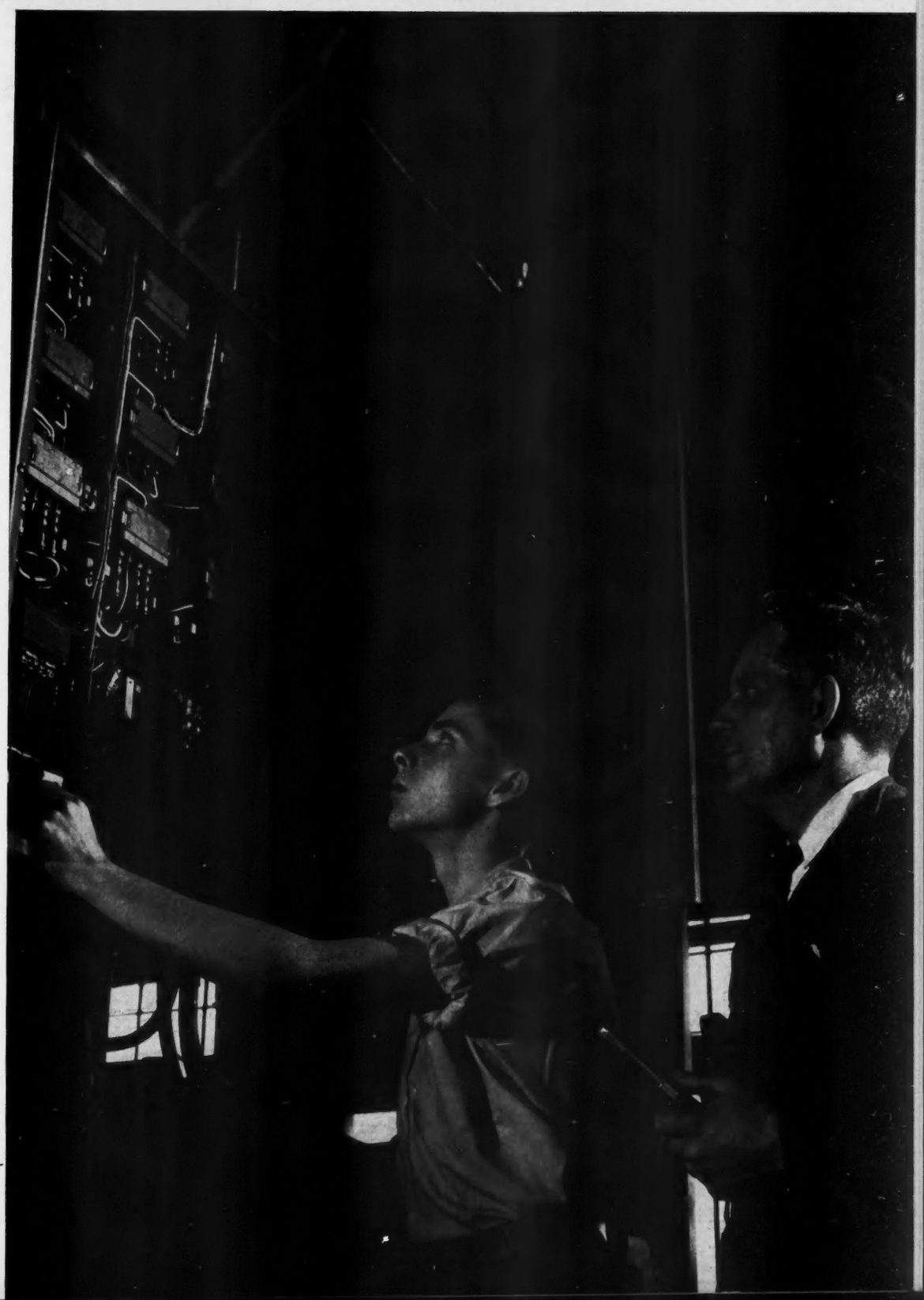

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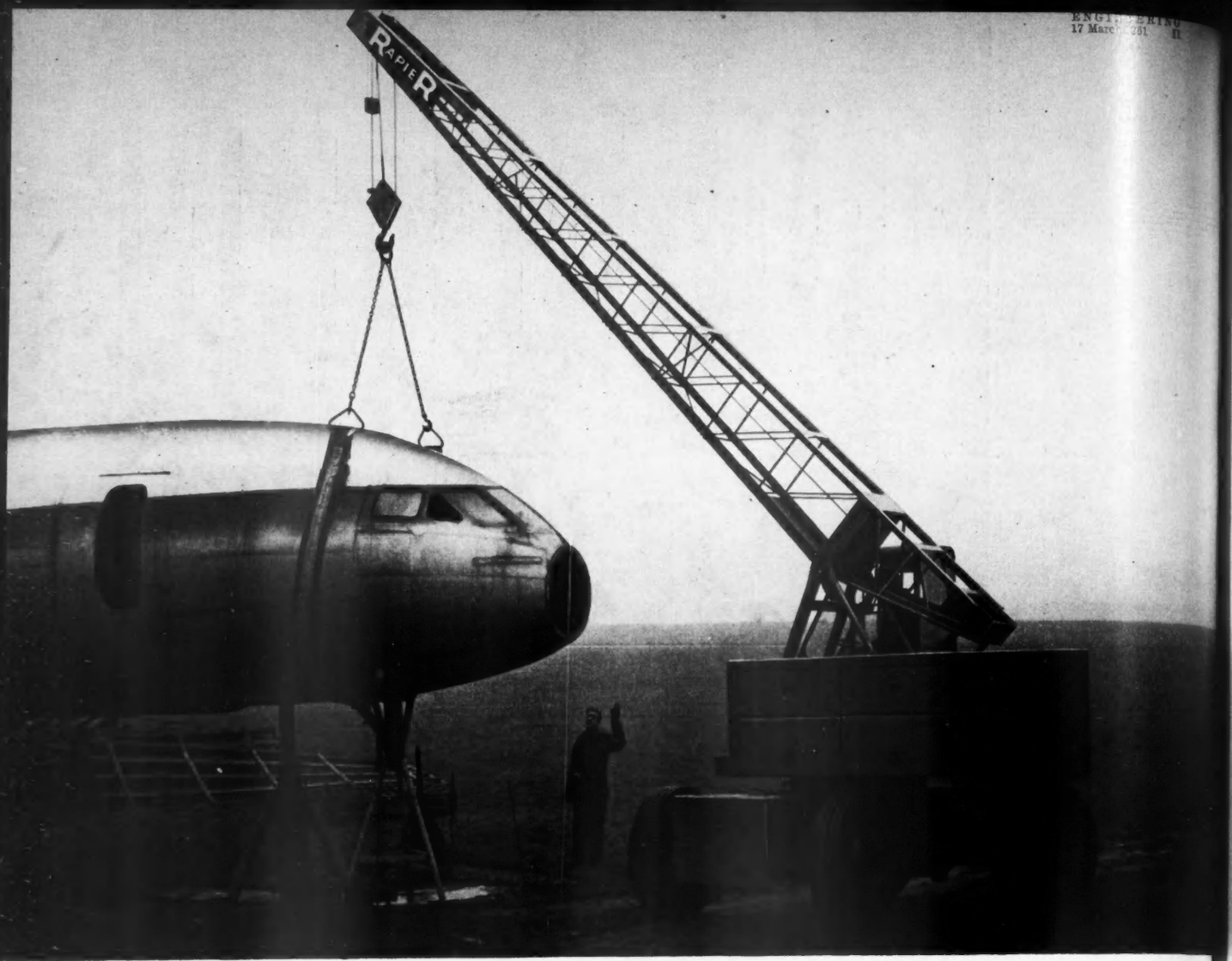

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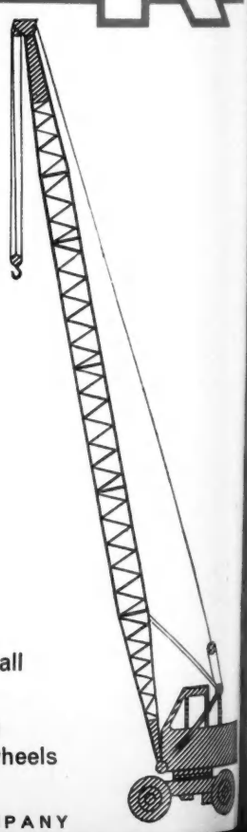

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Maintenance staff checking the electronic control of a new machine installed for operations on crankcases. (*Nurnberg photograph for* ENGINEERING)

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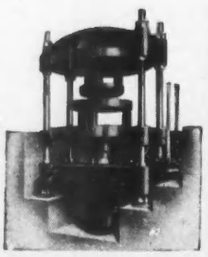

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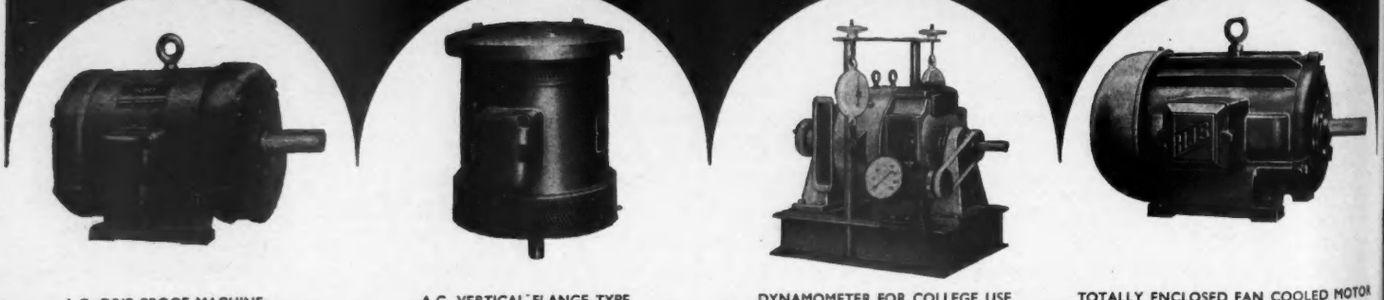

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ENGINEERING Impact

of Engineering Studies in London Schools

THE London County Council's educational responsibilities are so vast that when it produces a pamphlet *Engineering Studies in Secondary Schools* the statement of plans for the future is of serious significance for all the engineering industries.

The LCC report that within two to three years some 90 London secondary schools will be offering engineering courses for pupils up to the age of 15+; that 47 of these schools will also be offering courses up to the age level 16/17 and that 27 schools will be providing advanced courses for students up to 17/18.

Recognition of "the urgent and increasing national demand for graduate engineers of the very highest quality" is given by the LCC inspectors when they say that schools organising engineering courses must do so over the whole range of their pupils abilities, and especially for the most able. This is where the comprehensive school, offering courses over a wide range of types and levels, has an advantage compared with the smaller unilateral school.

The too narrowly vocational nature of the pre-1944 technical schools is now widely recognised. In many other countries than Great Britain the importance of equipping engineers in their early training with a background of science and something more than an acquaintance with the humanities has been recognised and acted upon since the end of the Second World War. This movement has gone on at all levels.

Science and History

Pioneering work in broadening the engineers' syllabus has been done, for instance, at the Massachusetts Institute of Technology where without lessening the rigours of teaching and research standards, science, social studies and the humanities have all been given a new place. The MIT way of doing things is well illustrated by the lectures of Aldous Huxley as Visiting Professor of Humanities.

At the particular levels with which it is concerned the LCC lays emphasis on maintaining general education and carries English, music and history well on into its courses.

In the main, courses will follow this pattern:

First and Second Years

General education based essentially on English, mathematics, science, history, geography, art, music, modern languages, woodwork, metalwork, physical education and games, religious education.

Third Year

General educational work continued with introduction to specialist studies, including geometrical and engineering drawing, metalwork tending towards engineering practice.

Fourth and Fifth Years

General Certificate of Education "O" level in English, mathematics, physics, chemistry, engineering drawing, engineering workshop theory and practice.

Sixth and Seventh Years

Leading to "A" level in pure and applied mathematics and physics and engineering drawing.

History, geography, modern languages, art and music are to be included throughout these years, not necessarily with the idea that they should be taken in external examinations.

The LCC is well aware that for very many of its pupils it will be important for them, and essential to industry, that they should continue their education after school at technical colleges. To this end the pamphlet, which has been prepared by LCC inspectors, recommends that principals of technical colleges and heads of departments be brought into consultation at an early stage.

Workshop Practice

Another sensible recommendation is that the workshop element in courses should be regarded not simply as metalwork but as engineering workshop theory and practice.

For the potential professional engineer the appropriate course envisaged aims at "A" level GCE passes in pure mathematics and physics. It is something of an understatement for the inspectors to add that a third "A" level subject (applied mathematics or chemistry) would be to the student's advantage.

Engineering Studies in Secondary Schools points to a lively appreciation at the LCC of the need in engineering for thoughtfully educated recruits of a wide variety of aptitudes and aspirations.

Two Trends in Steel Spending

Despite weakening demand at some works for steel sheet and a seasonal fall in the requirement for tin plate, February's output of steel was running at an average of 485,300 tons a week, one per cent higher than in February, 1960. Production for the month was not up to the high level of last autumn but it was consistent with the expected 24 or 25 million tons which are the predicted total for 1961.

Pig iron output, averaging 302,400 tons a week, was also a little above the same month of last year.

Reviewing the capital investment in iron and steel during 1960, the Iron and Steel Board calculates the amount spent as £146 million, almost 50 per cent more than in 1959. This heavy outlay was close to the total of estimates made by the individual companies at the beginning of 1960, a situation which contrasts with earlier years when the actual spending has regularly fallen short of the first estimates.

More for Mills

Largely because of the work on the new wide strip mill plants in Wales and Scotland, increased total capital expenditure is expected this year.

Two opposing trends are going on in the capital spending of the steel industry. On coke ovens capital investment has declined from 9 per cent of capital expenditure in 1958 to an estimated 5 per cent this year. On blast furnaces and raw material treatment, spending of 25 per cent in 1958 will have been reduced to 16 this year.

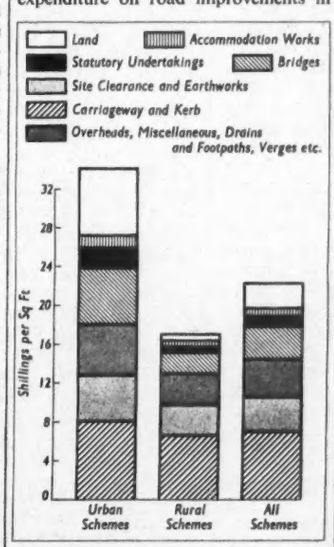
Increasing investment is going on for mills and finishing capacity, from 47 per cent in 1958 to a planned 58 this year, and from 13 on melting shops to 18 per cent.

This change in the proportions of spending in iron and steel is partly the result of the heavy initial spending on the rolling mill units at the wide strip mills.

of Relative Road Improvement Costs

Like it or not, the amount of new or improved roads provided each year is closely connected with the amount of money the Government is willing to spend. For this reason Mr. R. F. Dawson's *Analysis of the Cost of Road Improvement Schemes*, which is the fiftieth Road Research Laboratory technical paper, is of general importance in considering the benefits of road improvement in relation to the money to be spent.

From Ministry of Transport information on more than 200 schemes on classified and trunk roads in England and Wales it was calculated that the expenditure on road improvements in



Main components of Road Improvement Costs.

1958 averaged £1·11 per sq. ft. From an average of £1·68 in urban areas the cost declined to an average of £0·83 in rural districts.

The proportionally heavier burden of land costs in urban road schemes is reflected in the expenditures on road works alone. In urban schemes road works accounted for £0·88 per sq. ft, about half of the average for total costs per sq. ft. A much higher proportion of the total spending on rural schemes is for road works alone—£0·73 in the average total of £0·83.

The cost per mile of new dual carriageways in urban areas, £511,500, against £256,200 in rural districts, underlines again the economic reason why it is easy enough to undertake motorways from one traffic jammed city to another although the worsening traffic conditions of the big centres stay as intractable as ever.

One of the most interesting findings of the inquiry was that economies obtainable from increasing the size of schemes were very limited. Average costs per sq. ft were found to fall with size up to an area of 20,000 sq. ft which is itself a relatively small amount of roadway. In urban schemes it was discovered that a tendency existed for the lowest costs to be associated with the middle range of areas. No large or systematic variation was found in road work-only costs in schemes above 20,000 sq. ft.

Of the schemes involving less than 10,000 sq. ft more than 60 per cent were for widening single carriageways, the most expensive type of improvement. *Analysis of the Cost of Road Improvement Schemes* is published for the Department of Scientific and Industrial Research by the Stationery Office, price 1*s* 9*d*.

A New Look at Scotland's Future Power Schemes

The thorny question of the relative merits of hydroelectric and thermal methods of generating electricity is to go to a departmental committee appointed by Mr. J. S. Maclay, Secretary of State for Scotland. Until the committee has reported, further hydroelectric schemes in Scotland will not be allowed to go ahead.

One particular scheme on which the final decision whether or not to go forward will be held up is the £4·2 million project for making use of the waters in Glen Nevis. It seems probable that the hearing of objections to the Glen Nevis scheme, 25 have already been lodged, may go on at the same time as the deliberations of the new committee.

Advances in the economy of thermal generation have substantially altered the relative cost position of the two methods in which the high initial cost of hydro-electric schemes compared with fuel burning stations has, in the past, been counterbalanced by the cheapness of the subsequent running.

All Scotland Review

Eighteen years ago, the Cooper committee submitted a report which was followed by the establishment of the hydroelectric authority and now the water power resources of the Highlands provide electricity for 92 per cent of the potential consumers. The Cooper Committee reported on the north of Scotland while the new committee, to be presided over by Mr. C. H. McKenzie a former chairman of the Federation of British Industries' Scottish Committee, will cover the whole of the country.

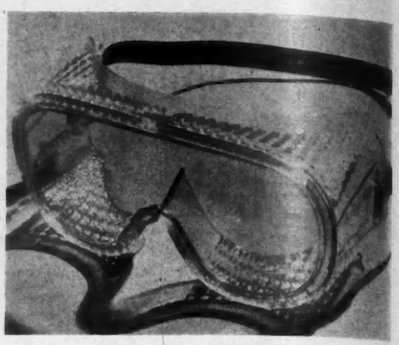
Its terms of reference are:

To review the arrangements for generating and distributing electricity in Scotland having regard to the availability and cost of hydroelectric power and of other sources of electricity; the rate of increase in the demand for electricity; and the needs of the remoter areas, and to make recommendations.

The outcome of the McKenzie committee's work will be important to the heavy electrical industry in Britain, to the civil engineering industry and not least to the future industrial development of Scotland. The task of looking into future developments in thermal and nuclear generation and into methods of distribution is not an enviable one.

Transparent Pvc is Fireproof and Tough

Pvc needs no introduction as a chemical resistant plastic. But did you know that it could be supplied as a transparent material - as sheet or film? This alone has created several large markets.



***Optically Clear.**—These applications show how toughness can be combined with optical clarity in clear pvc. The Planet windscreen made by Strafford Auto Components is shown fitted to a Lambretta. Lenses of the industrial safety goggles are made by Cascelloid for Fleming Safety Equipment.*

NATURAL pvc polymers are clear, but they have normally to be pigmented or coloured to stabilise them against thermal degradation during processing or natural ageing, which both cause yellowing. There are, however, some clear stabilisers which have the same refractive index as pvc and can be added at an early stage of processing so as to prevent yellowing. These stabilisers are rather expensive, and clear grades of pvc sheet carry a small premium because of this. But they do exist. Thus BX Plastics process clear Geon material and sell it under the name Cobex, and ICI are known to have a formulation which they may soon be marketing in sheet form.

In applications where translucency or transparency are needed, such as for roof lights, windscreens, or chemical tanks, this clear pvc comes up against competition from polymethyl methacrylate (Perspex), glass reinforced polyester sheeting, and of course, glass itself. Of these, glass is still by far the cheapest, and is second—by a small margin—only to Perspex in its good light transmission characteristics. But it is brittle in the untoughened state and the toughening process is only economically carried out on large runs of identical sized panels. Also, glass is not easily fabricated or formed. It is for applications demanding such properties that the other materials are making large inroads. Around this page you can see examples of where Cobex transparent pvc is being used.

Transparent pvc is basically of the high strength, unplasticised variety. In other words, initial tensile strength is about 8,000 lb per sq. in, falling to about a quarter of this value after ageing, and impact strength is very much greater than any competing clear material, certainly above about freezing point. Safe working temperature in most environments is below 65° C which compares with about 85° C for Perspex and 110° C for a general purpose reinforced polyester. The limit on plain glass when used in fabricated vessels is that of the jointing media, but would be higher than any of these. Viton, for instance, will stand 250° C.

The cost of transparent pvc supplied in corrugated form for roof lights at 0·080 in thickness is around 8*s* a lb, which compares with about 6*s* 6*d* a lb for Perspex at 0·125 ($\frac{1}{8}$) in thickness. Glass reinforced polyester normally undersells Perspex by a 20 to 40 per cent differential. It would be unwise, however, to take these figures as anything but a vague indication for calculating cost per sq. ft of coverage, as this depends on thickness required for a given span. Also, prices quoted by suppliers do vary considerably—especially for glass reinforced polyester where quality can vary and where there is a choice of flammable or non-flammable sheets.

For roof light applications, the non-flammability of pvc is attractive, certainly compared with Perspex, but pvc softens at a lower temperature, and slight yellowing will occur over a period of years to reduce a light transmission value which is already lower than that of Perspex or glass. But it is still going to remain above about the 50 per cent mark, which is quite acceptable for industrial buildings, and is comparable with glass reinforced polyester sheets. Resistance to weathering (primarily embrittlement) is not as good as for Perspex.

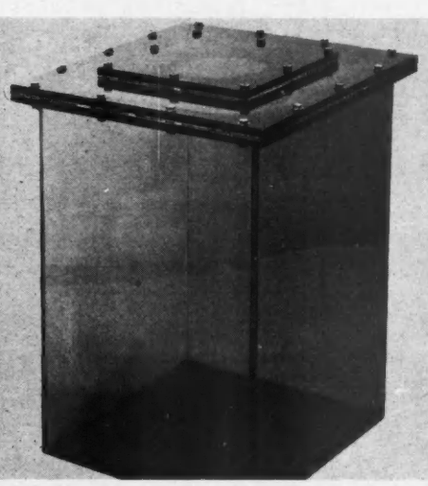
For chemicals, you will still often see tanks made from glass sheets even though joining techniques are limited to clamped joints with gaskets or fillers. And this is one field where the other three materials are up and coming. Thus, where transparency in a chemical tank is required, glass reinforced polyester can be made unpigmented to virtually any shape (although this job should strictly be left to a moulder who knows his formulations and lay-up techniques).

For true versatility in shop fabrication where a transparent structure is needed, there remain pvc and Perspex. There is little to choose between the materials in terms of chemical resistance, but advice should be sought on individual examples, especially those involving organic solvents. Joining of Perspex is normally carried out with a cement which under the best conditions can yield a joint with about 80 per cent the strength of surrounding sheet. Clear, rigid pvc can be joined by cements, by solvent adhesives, or by hot air welding—which allow gaps and cracks to be filled. Joints approach the strength of surrounding materials and are said to retain high impact values and good chemical resistance. Pvc has an advantage in that it can be cold formed such as for bending round corners. Perspex, like pvc, can be formed after softening.

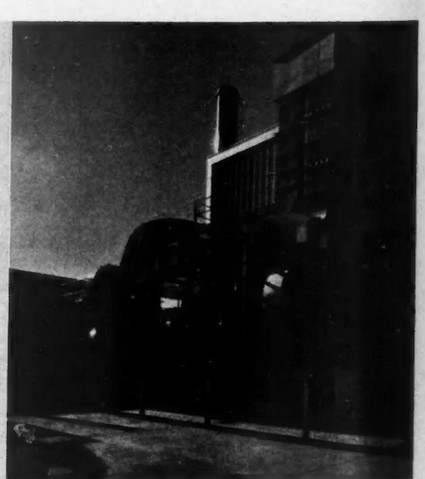
With the marketing by BX Plastics of transparent pvc sheet with the latest stabilisers, extruded so as to give high impact strength, it does appear that a very versatile material is on the market.

BX Plastics Limited, Higham Station Avenue, London, E4.

***Industrial Cladding.**—Corrugated sheeting used by F. W. Berk to clad this remotely controlled process plant was in amber coloured pvc. Corrosion resistance is better than for painted steel.*



***Chemical Tank.**—Made in transparent pvc by Tanks and Linings, this will contain hydrogen peroxide. Seams are hot air welded and gaskets have ptfe envelopes. It is 18 in by 17 in by 26 in.*



***Fume Ducting.**—This UKAEA installation by Turner and Brown facilitates inspection of the ducting. It is made from $\frac{3}{8}$ in thick transparent pvc with an outer layer of higher impact pvc.*

Flameproof Fibreboard Resists Moisture

A pressure impregnated fibreboard called Pyrestos Dribord is now being sold. This right-through impregnation means that there is no risk of flame spreading unseen along the back of a lining, while cutting, rebating or grooving do not reduce its fire resistance, say Pyrestos, the company who sell it. The material has good moisture resistance and will absorb sound in the same way that untreated fibreboard does. It can be obtained either pale fawn or painted on one side in white.

Pyrestos Limited, 8 Buckingham Palace Gardens, London, SW1.

Propane for Gas-Operated Trucks

The Calor Gas (Distributing) Company has now decided to supply the majority of its fork-lift truck consumers with propane instead of butane fuel. This switch of liquefied petroleum gases is the result of tests at Calor's research and development establishment at Addlestone. In these, test engines with frozen-up carburation systems repeatedly failed to start on butane but fired immediately when switched over to propane.

This better starting is attributed to the fact that propane is stored under greater pressure than butane and vapourises easily at extremely low temperatures. Calor say there is no visible or aural indication of any change in performance of the engines concerned when running on propane.

It appears that few if any difficulties will be presented by the changeover. For instance, propane is being supplied in the same cylinder as butane, although the shroud surrounding the valve equipment is painted red and the stencilled words Calor Propane appear on the casing. The liquid volume of propane supplied in the Mark XII cylinder is the same as butane, although its actual weight is slightly less owing to its lower specific gravity. Calor add that the price of propane per lb is the same as for butane, and the storage and handling characteristics are also the same.

Calor Gas (Distributing) Company Limited, 178 Great Portland Street, London, W1.

Plastic Laminates 12 ft by 5 ft

Arborite Company import plastic laminates from Canada, and they have found during one year of selling the materials in the UK that their prices at around 4*s* a sq. ft are quite competitive. Normally, these laminates arrive in the form of thin sheets, $\frac{1}{16}$ in thick, which can be laminated to furniture with an adhesive such as Evostick.

There is a very large range of patterns and the company are able to offer what are believed to be the largest standard sheets of this sort of decorative laminate made in the world—measuring 12 ft by 5 ft.

Arborite Company (UK) Limited, 54-88 Uxbridge Road, Ealing, London, W5.

Protective Paper Sticks Only to Itself

Spicers are now making a packaging material based on kraft paper with an adhesive on one side which will stick only to itself. It is called Spi-seal. When folded around a component the paper sticks instantly to itself so as to keep out dust and to protect against scratching.

The makers say that the adhesive is completely neutral and causes neither staining nor discoloration on paints, lacquers and varnishes. Standard Spi-seal is not claimed to provide complete corrosion protection, but in providing a near-impervious envelope it will reduce atmospheric attack.

The new material can be used either for hand packing or, with special-purpose machines, for flow-line packing. It can also be used in most heat-sealing units designed for thermoplastic film packing, but at a much higher rate, since no heating and sealing dwell are required. Reels can be obtained up to 45 in wide.

Spicers Limited, Langston Road. Loughton, Essex.

Collapsible Ducting in Resin Coated Glass

The extreme light weight and ability of a new type of ducting material to be reformed after crushing may find it applications other than those for which it was designed. The original problem, posed by the aircraft industry, was to pass a 2 in diameter duct having a right angle bend and a $\frac{1}{2}$ in flange on either end through a 2 in diameter hole in a bulkhead panel to connect two main air ducts.

Allowance had to be made for misalignment and this was done by including a built-in nylon corrugation. Baxter, Woodhouse and Taylor, who made the ducting shown above, experimented with several resin compounds. The one now used is not revealed by the makers, but it is reinforced with Fothergill and Harvey's glass fibre cloth. Advantages claimed for the ducting include good air flow, non-corrosiveness, lightness, resistance to heat and chemicals and durability. In addition, the makers claim that brittleness, one of the most important faults of previous types of resin impregnated glass cloth ducting, has been overcome.

Baxter, Woodhouse and Taylor Limited, Poynton, Manchester.

Handling Liquid Oxygen

An extensive programme for modernising and extending liquid oxygen distributing and dispensing equipment has been launched by British Oxygen. Under the new system, BOC liquid tankers, fitted with electrically operated pumps, deliver liquid into an evaporator in consumers' works at a pressure up to 300 lb per sq. in.

New vacuum insulated evaporators have been designed and manufactured by BOC's Engineering Division, and existing cold evaporators are being modified to take pressure filling. The system will be extended to include liquid nitrogen and liquid argon.

With these new units and the modified cold evaporator, fresh supplies of liquid can be pumped in without interruption of customers' demand. The pump filling operation is twice as fast as the conventional decanting method. Other advantages of these pressure filled systems to the consumer are: the plant is entirely automatic and maintains a predetermined pipeline pressure. It does not need a plant hand in attendance, thus saving cost. In general, plants will give consumers greater storage than at present as increased efficiency of the insulation makes this practicable. All future plants can be installed out of doors which saves the consumer the expense of building a special plant house. The efficiency of the insulation permits negligible loss at weekends, holiday or low demand periods.

These vacuum insulated evaporators have now been in operation for over a year in the UK and there are 30 units operating.

British Oxygen Company Limited, Bridgewater House, St. James's, London, SW1.

Epoxy Bonding —and Pattern Making

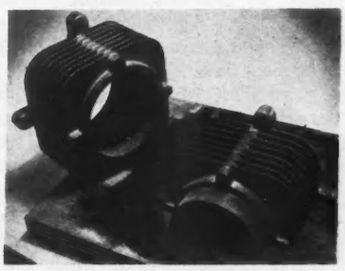
Illustrated at the top is a tube which forms part of the ejection seats made by the Martin-Baker Aircraft Company. When the explosive charges are detonated, the pilot's seat is propelled from the aircraft by a piston mechanism operated

inside this gun cylinder tube, which itself remains attached to the aircraft.

Two-part epoxy resin—Araldite made by CIBA—was used to attach lugs and fittings to the basic tube without affecting its smooth inside bore. This method of construction also provides joints strong enough to withstand forces produced by the explosives. Most of the lugs are for attachment of guide rails along which the seat travels, and the circular attachments seen on this tube are for housing the explosive charges.

The same basic epoxy resin has been used by J. Hobkirk Sons and Company for casting a foundry pattern. This is said to have saved a great deal of time compared with making one in aluminium.

Note, though, that for small numbers of castings it is still current foundry practice to use wooden patterns, and when making an epoxy pattern for longer runs it is still necessary to go via the stages of making a wooden, plaster or wax model first. The finished epoxy pattern—the one here is for manufacture of rotary compressor unit bodies for Cooper-Stewart Engi-



neering Company—is said by CIBA to have much better wearing properties than one in aluminium.

CIBA (ARL) Limited, Duxford, Cambridge.

Plain Words

By Capricorn

IT seems to be a modern occupational disease to take work home. The executive with his bulging briefcase is a familiar and depressing image. Contrary to popular belief, the briefcase does not contain oranges, sandwiches, a novel, or presents for his wife, but copious quantities of tiresome documents, reports to read, examination papers to be marked, a slide rule, engineering drawings, notes for a lecture, all the portable paraphernalia of human and administrative overheads.

Do not imagine that the briefcase needs to bulge. Its slave will only work upon a fraction of its contents. But on Friday night, when he gathers his papers together, he is always far too tired to make decisions or plan a reasonable and limited working programme. He therefore takes the lot. So every weekend hanging over him is a superhuman task—or a guilty conscience.

Because the weekend seems so full of potential working sessions—mornings, afternoons and evenings, two of each—he never quite gets down to it. On Saturday morning he feels jaded and puts it off till later; Saturday afternoon—well, he must have some fresh air, and goes off to watch the "extra A," three men short, defeated by enormous odds. Television with " Candid Camera " or the captivating satire of Anthony Newley claims his attention in the evening. But all the time, just beneath the surface, he is worrying.

On Sunday he doesn't quite get up in time to catch the early service; the morning passes with very little done; the afternoon his wife puts down her foot and says the children (or the dog) must be taken for a walk. The evening is a frantic struggle to finish something before the television play begins. He fails. Working against a background of low-volume melodrama, he curses himself for ruining the weekend—and finishes at midnight.

The following week he gets even more behind.

I know just how he feels. I too have worked at home. Indeed, I have often done so for no better reason than the fear that I may waste the weekend; but if I do some office work I shall at least have something to show for it. This argument infuriates my wife.

My friend Jelks says it's just bad management—or a sign of mental exhaustion. He works in a bank. I have to agree with him to some extent; but in a growing organisation where new systems are continually being created, there is always more work than can possibly be accomplished—and not much can be delegated. No doubt in a bank, where systems and procedures have long been formulated, the situation is entirely different.

Out of the corner of my eye, I've just seen the Sunday play draw to its shattering conclusion. I bet I feel like death tomorrow.

Letters to the Editor

Can Design be Taught at Universities?

SIR, At long last, there seems to be a stirring of interest in the design aspects of engineering. I hope it may continue and, perhaps, do something to slow up our increasing dependence on manufacturing under licence, to foreign designs.

I do not think that design—or research for that matter—can be taught, as such.

Given a resonable modicum of ability and keenness on the part of the student, the good teacher will lead his students along the right paths, and encourage them to appreciate and strive after their ultimate goal. Thus, an atmosphere has been successfully created in which research has been exalted as the thing to go in for, with a glamour of its own.

To stimulate a corresponding interest in design needs a realisation that research is only the raw material for design. In the physical sciences, design follows on from research, and is its logical sequel. Equal human qualities are needed in both activities.

Active design work is, or should be, like research, a post-graduate activity. Undergraduate exercises towards it must include plenty of freehand sketching and drawing, as well as geometrical lay-out work. (The Greeks of classical times devoted great attention to geometry, particularly in the intrinsic beauty of the conic sections.) What higher or finer example of this is there than the inherent geometry of a spiral bevel gear-cutting machine? This work should be common to all engineering students, so that those with talent can acquire, through practice in drawing things that already exist, the power to conceive and delineate things that do not yet exist at all, but are thereby defined and given the possibility of material existence.

Those without talent may spend less time on this work; what they do spend will not be wasted. They will at least acquire some appreciation of what is involved. There is nothing menial in an engineer's drawing board, any more than there is in an architect's, or in an artist's easel.

No teacher need be a genius in the field in which he is teaching. He must, however, have a reasonable degree of competence in addition to being a good teacher. There seem to be all too few people of the right calibre in the teaching world, people who have had sufficient practical experience in design as to be able—not so much to teach the subject as to stimulate real interest in it at the right intellectual level—and to do something to encourage the development of a true sense of values.

So long as industrial firms fail to recognise the importance of good design work, or give adequate pay or status for it, and so long as the professional institutions utterly neglect it (as they seem to do) few ambitious young men will take it seriously, however capable their teachers may be. There will not be that sense of purpose and achievement, such as my generation of students felt—over-optimistically perhaps—50 years or more ago.

In schools of architecture, art, medicine, music and law, much, if not all, of the higher direction is done by men actively engaged in their professions. Much of the sense of purpose would be regained if this were the case with university schools of engineering. There are, however, not enough good men of the right calibre to undertake this direction, and there never will be unless the university organisations take the matter seriously.

Industry, the professional institutions, and the universities must share the blame for our present state of inadequacy with the Royal Society, which, founded by a group of very able men all keenly interested in the practical applications of the new knowledge they were acquiring and collecting, has passed through many stages, including that of a club for dilettante gentlemen. In its present state, neither engineering nor technology are represented *by* it at all—for all practical purposes—in spite of its being an official advisory body to the Government.

Oddly enough, the Royal Society of Arts and the British Association for the Advancement of Science, both of which were founded specifically to fill the gap caused by the too highly selective attitude of the Royal Society, have rather tended to lose their original purpose by neglecting the practical side of things.

In small power electrical work (and even more in electronic work), it is becoming more and more the case that the " design " is done in the laboratory; rigging up components on a bread-board model. In fact, this method is usually the only way to do it, but who designs the components? Drawing is limited to circuitry, usually in purely symbolic form, and production design starts from the bread-board model, with a different set of men.

A generation seems to be growing up which thinks that this analytical and experimental work is all that is needed; that the publication of a paper on it is the main thing; and that mechanical engineering design work can be either left to a lesser breed of men, or can be done in the same way, omitting all the precision of thought and clarity of expression involved in real design. Here, the drawing board or sketch block is the place where all the thought must be concentrated and expressed; and, here, the thing has to be carried right through—to the production drawing stage—with responsibility for ultimate performance.

Something must be done to correct the present fallacy that, whereas science and research are worthy activities for the higher intellects, design and manufacture are not. One of the main centres where effective remedial steps could be taken is in the university organisations. Their own schools of medicine and law may, perhaps, be able to help in coordinating the academic outlook with the necessary professional competence.

Yours faithfully,
HUGH CLAUSEN.

London, NW2.
11 March, 1961.

Noise Annoyance

SIR, I read with interest the British Association paper by Professor E. J. Richards on " Noise Annoyance and Its Assessment," published in your journal (ENGNG., 9 Sept. '60, p. 362).

Any article such as this which publishes definite information about such a subjective thing as noise (defined in BS 661:1955 as " sound which is undesired by the recipient "), and helps to establish a rational basis for it is to be warmly commended.

Some of the points discussed in the article appear to raise further questions. These include

(i) the aircraft noise frequency spectra in Fig. 2 and their relation to those in Fig. 3,

(ii) the title of Fig. 2,

(iii) the horizontal distance scale in Fig. 7b,

(iv) Fig. 4, Table I and the comments on them in the text,

(v) the formulæ for total noise, and

(vi) the difficult problem of acceptable noise levels.

Dealing with these six points in order, may I make the following comments:

(i) While the text of the paper states that the two spectra of Fig. 3 have been superimposed on to the equal annoyance contours of Fig. 2, examination of these figures indicates that obvious errors of superposition have been made. Firstly, the noise spectra in Fig. 2 do not extend sufficiently to the right to the uppermost octave bands. Secondly, their octave band levels in Fig. 3 are often 6 decibels (dB) lower than those in Fig. 2. Information in the text (SPL for propeller plane = 107 dB, etc.), and calculations shown in the Table appended below suggest that the levels in Fig. 2 (when allotted to the right frequency bands) are the correct ones.

(ii) The title of Fig. 2 is given as " Curves

showing the response of the ear to pure tones and bands of noise." Because the equal loudness contours appear to be those of S. S. Stevens for octave bands of noise (published in his article "The Calculation of the Loudness of Complex Noise," *J. Acoust. Soc. Am.*, Sept., 1956), and because the horizontal axis is definitely marked in octave bands, "Curves showing the response of the ear to octave bands of noise in terms of equal loudness and equal noisiness" would perhaps be a better title.

(iii) There appears to be no reference at all in the text to the horizontal distance scale of Fig. 7b. Is "miles" correct?

(iv) The relations between Fig. 4, Table I, and the comments in the text are not altogether clear. Also

(*a*) The vertical axis of Fig. 4 has no scale.

(*b*) Should not the percentages in Table I, column 2, add up to 100?

(*c*) Should not the second percentage in Table I be 67 instead of 37?

(v) The formulae given for calculating "total noise (N_T) and "perceived noise level" (in PNdB) appear to be analogous to those given by S. S. Stevens for the calculation of loudness and loudness level of a complex noise from its known octave band levels and his equal loudness contours for octave bands of noise (*J. Acoust. Soc. Am.*, Sept., 1956). Where S is loudness in sones and P loudness level in phons, total loudness, $S_T = S_{max} + 0{\cdot}3\ (\Sigma\ S_r - S_{max})$ and loudness level, $P = 40 + 33{\cdot}3\ \log_{10} S_T$ (or $S = 2^{(P-40)/10}$). On this basis the formula for total noise (N_T) should be $N_T = N_{max} + 0{\cdot}3\ (\Sigma\ N_r - N_{max})$, and a check calculation of the perceived noise level of aircraft noise (appended below) appears to confirm this. In the paper, the capital sigma (Σ) in the formula quoted has been placed in front of 0·3 instead of N_r*.

(vi) The problem of "acceptable noise levels" is a difficult one, and there appear to be two distinct critical noise levels. The lower of these is the level below which there would normally be no complaints of noise. Under normal circumstances it may be expected to vary between sound pressure levels of 50 and 70 dB (re 0·0002 dyne per sq. cm) and to depend to some extent on the general level of background noise.

The upper of these levels is that above which for most people the noise is absolutely intolerable because it is extremely loud and hurts the ears. This level probably lies between sound pressure levels of 100 and 120 dB.

Thus, the lower level corresponds with such criteria as speech interference level, while the upper is close to the threshold of feeling of pain. Between these two limits people are prepared to put up with a certain amount of noise and are happier when the noise level is nearer the lower critical level. If there is no sign of the noise being reduced in level, people eventually become resigned to it, particularly if each burst of noise is not very long (perhaps ten seconds at most) and bursts do not occur too frequently. The noise (i.e., it is still undesired) is then considered by the authorities to be "acceptable."

Thus, on the one hand, we have people, now with the support of medical and psycho-acoustic evidence, calling for very considerable reductions in noise; while on the other hand, we have the various business organisations and public authorities being unwilling to reduce their noise any more than they absolutely must, because the reduction of noise by any considerable amount is often a difficult, and usually very expensive, matter.

Yours faithfully,
C. L. FOUVY.

Melbourne,
Australia.
3 March, 1961.

* *Editor's Note:* Professor E. J. Richards has himself drawn attention to this point in a letter (ENGNG., 16 Sept. '60, p. 373).

Events in Advance

Locomotive Engineers to Celebrate Their Jubilee

PROVISIONAL arrangements have now been made by the Council of the Institution of Locomotive Engineers for the holding of a series of events in London, on 10 to 12 May, to mark the fiftieth anniversary of the founding of their Institution.

The proceedings will open with a golden jubilee luncheon at the Dorchester Hotel, Park Lane, London, W1, on 10 May at 1 p.m.; preceded by a reception by the President of the Institution, Mr. D. C. Brown, C.B.E., at 12 noon. At 5.30 p.m. on the same day, General Sir Brian Robertson, Bt., the chairman of the British Transport Commission, will deliver the Sir Seymour Biscoe Tritton Lecture at the Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. An all-day visit to some place of interest is being organised for the following day, 11 May.

On 12 May, there will be an exhibition of locomotives "past and present" at the Railway Goods Yard, Marylebone, NW1, which is being arranged by the British Transport Commission to mark the occasion. The celebrations are to end with an informal dinner, followed by dancing, at the Dorchester Hotel at 7.15 p.m. on the same day. Additional information is obtainable from the secretary, the Institution of Locomotive Engineers, 28 Victoria Street, London, SW1, or by telephoning ABBey 6672.

Exhibitions and Conferences

Farnborough Flying Display and Exhibition.—Mon., 4 Sept., to Sun., 10 Sept., at Farnborough, Hampshire. Open to the public on Fri., Sat. and Sun., 8, 9 and 10 Sept., only. Apply to the Society of British Aircraft Constructors, 29 King Street, London, SW1. Tel. TRAfalgar 3231.

Machine Translation of Languages and Applied Language Analysis, International Conference.—Tues., 5 Sept., to Fri., 8 Sept., at the National Physical Laboratory. Organised by the Automonics Division, National Physical Laboratory, Teddington, Middlesex. Tel. Teddington Lock 3222.

Chemical Exposition, Eleventh National.—Tues., 5 Sept., to Fri., 8 Sept., in the International Amphitheatre, Chicago. Organised by the Chicago Division of the American Chemical Society, 86 East Randolph Street, Chicago 1, Illinois, USA.

Packaging Exhibition, International.—Tues., 5 Sept., to Fri., 15 Sept., at Olympia, London, W14. Organised by Provisional Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

Microwave Measurement Techniques, Conference.—Wed., 6 Sept., to Fri., 8 Sept., at the Institution of Electrical Engineers, Savoy Place, London, WC2. Associated with the conference will be an Exhibition of Microwave Measurement Techniques. Organised by the Electronics and Communications Section, Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. Tel. COVent Garden 1871.

Levant Fair, 25th International.—Wed., 6 Sept., to Thurs., 21 Sept., at Bari. Agent: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Fast and Intermediate Reactor Facilities, Seminar.—Thurs., 7 Sept., to Fri., 15 Sept., in Austria. Apply to the International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria.

Household Goods and Hardware Fair.—Fri., 8 Sept., to Sun., 10 Sept., at Cologne. United Kingdom inquiries should be sent to Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Ghent International Fair, 16th.—Sat., 9 Sept., to Sun., 24 Sept., at Ghent, Belgium. Agent: Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Vienna International Autumn Trade Fair.—Sun., 10 Sept., to Sun., 17 Sept., at Vienna. In the United Kingdom, applications should be made to the Office of the Austrian Foreign Trade Representative, 1 Hyde Park Gate, London, SW7. Tel. KNIghtsbridge 6938.

Cybernetics, Third International Congress on.—Mon., 11 Sept., to Fri., 15 Sept., at Namur. Apply to the International Association for Cybernetics, 13 Rue Basse Marcelle, Namur, Belgium.

Utrecht International Autumn Trade Fair.—Mon., 11 Sept., to Sat., 16 Sept., at Utrecht, Holland. For consumer goods. In the United Kingdom, applications should be made to Mr. W. Friedhoff, 10 Gloucester Place, London, W1. Tel. WELbeck 9971.

"Daily Mail" Food, Cookery and Catering Trades Exhibition.—Tues., 12 Sept., to Sat., 23 Sept., at the City Hall, Manchester. Organised by Provincial Exhibitions Ltd., City Hall, Deansgate, Manchester 3. Tel. Deansgate 6363.

International Civil Aviation Organisation (ICAO): North Atlantic Regional Air Navigation Meeting (Fourth).—Tues., 19 Sept., in Montreal (tentative). Offices of ICAO: Montreal, Canada.

Domestic Heating and Insulation-in-the-House Exhibition, First.—Tues., 19 Sept., to Fri., 22 Sept., at the Free Trade Hall, Manchester. Organised by Clarke and Rhodes Ltd., 274-278 The Corn Exchange, Fennel Street, Manchester 4. Tel. Deansgate 6541.

Caravan Exhibition, Third International.—Wed., 20 Sept., to Sat., 30 Sept., at Earls Court, London, SW5. Organised by the National Caravan Council, 37 Bedford Row, London, WC1. Tel. CHAncery 6102.

Radiofrequency Spectroscopy in Solids, Conference on.—Thurs. and Fri., 21 and 22 Sept., at Bangor. Organised by the Institute of Physics and the

TABLE:—*Noise Tests—Octave Band Analysis Results, and Calculation of Loudness (S_T) and Total Noise (N_T)*
(Octave band levels and noise values are from Figs. 2 and 3 and thus only approximate)

Test details		Band levels (dB)									Calc. sound level (dB)	Band loudnesses (sones) corresponding to band levels								Calc. loudness (sones)	Calc. loudness level (phons)
		0	I	II	III	IV	V	VI	VII	VIII			I	II	III	IV	V	VI	VII	VIII	
Propellor Aircraft Noise:	Fig. 2	107	96	102	102	95	87	79	74	65	106	Loudness	*25*	*56*	*71*	*48*	*28*	*18*	*18*	*10*	*132* (S_T)	*110½ phon*
												Total noise	25	46	67	49	29	23	26	20	132 (N_T)	110½ PNdB
	Fig. 3		90	96	95	88	81	76	72	65	99½	Loudness	*15*	*37*	*44*	*30*	*18*	*15*	*16*	*10*	*86* (S_T)	*104½ phon*
												Total noise	15	30	40	31	19	19	23	20	87 (N_T)	104½ PNdB
Jet Aircraft Noise:	Fig. 2		88	91	94	97	102	102	96	91	106½	Loudness	*13*	*26*	*41*	*56*	*79*	*90*	*84*	*74*	*202* (S_T)	*116½ phon*
												Total noise	13	22	37	56	74	98	98	113	232 (N_T)	119 PNdB
	Fig. 3		84	86	89	91	95	95	91	86	100	Loudness	*9*	*18*	*29*	*37*	*48*	*56*	*60*	*52*	*135* (S_T)	*111 phon*
												Total noise	10	15	28	37	49	65	74	80	163 (N_T)	114 PNdB

Total loudness, $S_T = S_{max} + 0{\cdot}3\ (\Sigma\ S_r - S_{max})$ and $P = 40 + 33{\cdot}3\ \log_{10} S_T$ (Stevens 1956).

Analogously

Total noise, $N_T = N_{max} + 0{\cdot}3\ (\Sigma\ N_r - N_{max})$ and $PN = 40 + 33{\cdot}3\ \log_{10} N_T$ (Beranek, Kryter, Miller, 1959).

Physical Society, 1 Lowther Gardens, Prince Consort Road, London, SW7. Tel. KENsington 0048.

Motor Exhibition, International.—Thurs., 21 Sept., to Sun., 1 Oct., in Frankfurt. United Kingdom agents: Lep Transport Ltd., Sunlight Wharf, Upper Thames Street, London, EC4. Tel. CENtral 5050.

Marseilles International Fair, 37th.—Thurs., 21 Sept., to Mon., 2 Oct., at Marseilles. Agents: Butler's Advertising Service, Fenwick House, 292 High Holborn, London, WC1. Tel. CHAncery 4224.

Fine Foods and Provisions Exhibition (ANUGA), Sixth.—Sat., 23 Sept., to Sun., 1 Oct., in Cologne. In the United Kingdom, applications should be made to Mr. Neven du Mont, 123 Pall Mall, London, SW1. Tel. WHItehall 8211.

Watch and Jewellery Trade Fair, Seventh International—Mon., 25 Sept., to Fri., 29 Sept., at Earls Court, London, SW5. Sponsored by the National Association of Goldsmiths. Open to trade and public. Organised by Trade Fairs and Promotions Ltd., Drury House, Russell Street, Drury Lane, London, WC2. Tel. TEMple Bar 3422.

Heating, Ventilating and Air Conditioning Exhibition (HEVAC).—Tues., 26 Sept., to Fri., 6 Oct., at Olympia, London, W14. Organised by Industrial Exhibitions Ltd., 9 Argyll Street, London, W1. Tel. GERrard 1622.

Heating, Ventilating and Air Conditioning, International Conference.—Wed., 27 Sept., to Wed., 4 Oct., at Olympia, London, W14. Organised by the Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. Tel. SLOane 3158.

Meetings and Papers

Association of Supervising Electrical Engineers

LONDON
Annual Dinner. Grosvenor House, Park Lane, W1. Fri., 7 April, 6 for 6.30 p.m.

British Institution of Radio Engineers

LONDON
"Transistorised Television Receivers": Discussion. Television Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Thurs., 6 April, 6 p.m.*
"Vibration Analysis and Testing," by D. E. Mullinger. Electro-Acoustics Group. London School of Hygiene and Tropical Medicine, Keppel Street, WC1. Wed., 12 April, 6 p.m.*
MANCHESTER
"Plant Investigation and Control, Using Digital Techniques," by K. J. McCarthy. North Western Section. College of Technology, Manchester. Thurs., 6 April, 7 p.m.

Building Centre

LONDON
"Keeping Out the Water": film, exhibited by the Natural Asphalte Mine-Owners and Manufacturers Council. Wed., 12 April, 12.45 p.m.

East Midlands Metallurgical Society

DERBY
"Recent Work on Cold Forming and Extrusion," by N. S. Angus. Annual General Meeting. Derby and District College of Art, Derby. Thurs., 13 April, 7.30 p.m.

Illuminating Engineering Society

MANCHESTER
Annual General Meeting and Discussion of papers by W. Carlton, G. Mawson and J. E. Torge. Manchester Centre. Offices of the North Western Electricity Board, Town Hall Extension, Manchester 2. Thurs., 13 April, 6 p.m.
SHEFFIELD
Lighting Forum and Annual General Meeting. Sheffield Centre. Grand Hotel, Sheffield. Mon., 10 April, 6.30 p.m.

Institute of Marine Engineers

LONDON
"Experience with Hardened and Ground Gearing in the Royal Canadian Navy," by D. K. Nicholson. Tues., 11 April, 5.30 p.m.
BRISTOL
"Details and Operating Data of Recent Alternating-Current Installations," by A. N. Savage. West of England Section. The University, Queen's Building, University Walk, Bristol. Mon., 10 April, 7.30 p.m.
LIVERPOOL
"Materials for Advanced Steam Conditions and Their Influence on Operation of Marine Turbines and Boilers," by Commander H. E. C. Hims. and S. H. Frederick. Merseyside and North Western Section. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool 2. Mon., 10 April, 6 p.m.

Institute of Metals

LONDON
"Physical Methods of Analysis for Major Alloying Constituents," by K. M. Bills. Annual General Meeting. Thurs., 6 April, 6 p.m.*

Institute of the Motor Industry

LONDON
Annual Dinner. Park Lane Hotel, Piccadilly, W1. Thurs., 13 April, 7.15 for 7.45 p.m.

Institute of Road Transport Engineers

EDINBURGH
"Special Servicing Tools for Heavy Transport Vehicles," by J. Blaber. Scottish Centre. North British Hotel, Edinburgh. Mon., 10 April, 7.30 p.m.
MAIDSTONE
Annual General Meeting. South Eastern Centre. Wig and Gown Hotel, Maidstone. Fri., 14 April, 7.30 p.m.

Institution of Chemical Engineers

BIRMINGHAM
"New Metals and Alloys as Materials of Construction": symposium, during morning session. "New Non-Metallic Materials of Construction": symposium, during afternoon session. Chemical Engineering Department, The University, Edgbaston, Birmingham 15. Wed., 12 April, 9.30 a.m. to 5.30 p.m.

Institution of Civil Engineers

LONDON
"Recent Works on the Canal System of the British Transport Commission and Planning for the Future," by V. H. Tripp. Tues., 11 April, 5.30 p.m.*

Institution of Civil Engineers
Institution of Mechanical Engineers and
Institution of Electrical Engineers

LONDON
"Resources, Human and Material, of the British Commonwealth," by the Duke of Edinburgh. Joint meeting of the three institutions at the Institution of Civil Engineers, Great George Street, SW1. Thurs., 13 April, 5.30 p.m.

Institution of Electrical Engineers

LONDON
"Applications of Electrical Phenomena at Liquid Helium Temperatures": Discussion, to be opened by Dr. R. E. Hayes. Electronics and Communications Section. Mon., 10 April, 5.30 p.m.*
"Precision Instruments for Coaxial Line Measurements up to 4 Gc/s," by D. Woods. Supported by a paper on "The Concept of Equivalent Source E.M.F. and Equivalent Available Power in Signal-Generator Calibration," by D. Woods. Joint Meeting of the Measurement and Electronics Sections. Tues., 11 April, 5.30 p.m.*
"The Calculation of the Magnetic Field of Rotating Machines"—Part II: "The Field of Turbo-Generator End-Windings," by D. S. Ashworth and P. Hammond; and "The Magnetic Field of the End-Windings of Turbo-Alternators," by P. J. Lawrenson. Supply Section. Wed., 12 April, 5.30 p.m.*
"Teaching Physics to Engineers": Discussion, to be opened by Dr. J. Topping. Education Discussion Circle. Wed., 12 April, 6 p.m.*
"Aluminium in Electrical Engineering," by P. J. H. Rata; "Diesel Railway Locomotives," by A. D. Swanston and B. W. Towell; and "Automatic Programmes for Hot Reversing Mills," by T. E. S. Rickard. Joint meeting of the London Graduate and Student Section and the Utilsation Section. Thurs., 13 April, 6 p.m.*
BELFAST
"Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," by Dr. J. S. Forrest, P. J. Lambeth and D. F. Oakeshott. Northern Ireland Centre. David Keir Building, Queen's University, Stanmillis Road, Belfast 9. Tues., 11 April, 6. 30 p.m.*
LIVERPOOL
"Mechanism of Lightning," by Professor J. M. Meek. Annual General Meeting. Mersey and North Wales Centre. Royal Institution, Colquitt Street, Liverpool. Mon., 10 April, 6.30 p.m.
MANCHESTER
"The Impulse Strength of Impregnated-Paper Dielectrics as Used in High-Voltage Cables," by Dr. B. F. Salvage and J. A. M. Gibbons. North Western Centre. Engineers' Club, Albert Square, Manchester. Tues., 11 April, 6.15 p.m.
SOUTHAMPTON
"High-Speed Pulse Techniques Using Transistors," by E. Wolfendale. Southern Centre. The University, Southampton. Tues., 11 April, 6.30 p.m.
YORK
"Some Notes on the Electrical Requirements of General Cargo Docks," by E. R. Radway. North Midland Centre. Royal Station Hotel, York. Tues., 11 April, 7 p.m.

Institution of Engineering Inspection

LEEDS
Annual General Meeting. Leeds Branch. Leeds Church Institute, Albion Place, Leeds 1. Tues., 11 April, 7.30 p.m.

Institution of Engineers-in-Charge

LONDON
"Use of Isotopes in Industry," by J. A. Frampton. Caxton Hall, off Victoria Street, SW1. Wed., 12 April, 6.30 p.m.*

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
"Cavitation Tunnel Tests with Merchant Ship Propellers," by H. B. Lindgren. Annual General Meeting. Tues., 11 April, 6.30 p.m.

Institution of Heating and Ventilating Engineers

LEICESTER
Annual General Meeting. East Midlands Branch. Grand Hotel, Leicester. Wed., 5 April, 6.30 p.m.

Institution of Mechanical Engineers

LONDON
"Application of the Flash Temperature Concept to Cam and Tappet Wear Problems," by A. Dyson and H. Naylor. Automobile Division. Tues., 11 April, 6 p.m.*
"Surface Contact in Theory and Practice," by Dr. F. T. Barwell. Nominated Lecture. Wed., 12 April, 6 p.m.*
BRISTOL
"The Potentialities of Accurate Control and Measurement in Engineering Manufacture," by Professor J. Loxham. Western Branch. Engineering Laboratories, The University, University Walk, Bristol. Tues., 11 April, 7 p.m.
LEICESTER
"The Effect of Nuclear Radiation on Engineering Materials," by Professor A. H. Cottrell: Thomas Hawksley Lecture. Preceded by Annual General Meeting. East Midlands Branch. College of Technology and Commerce, Leicester. Thurs., 13 April, 7.15 p.m.
MIDDLESBROUGH
"Inspection of the Primary Circuits and Reactor Pressure Vessels of Nuclear Power Plant," by H. N. Pemberton and E. Crossley. Nominated Lecture. North Eastern Branch. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough. Tues., 11 April, 6.15 p.m.

Institution of Plant Engineers

BRISTOL
"Electricity Supply and Distribution in Factories," by C. H. J. Bax. Western Branch. Grand Hotel, Broad Street, Bristol. Wed., 12 April, 7.15 p.m.
GLASGOW
"Plant Records": Discussion. Glasgow Branch. Scottish Building Centre, 425 Sauchiehall Street, Glasgow, C2. Thurs., 13 April, 7.15 p.m.
MANCHESTER
"Welding," by Dr. F. Koenigsberger. Manchester Branch. Manchester Literary and Philosophical Society, George Street, Piccadilly, Manchester. Tues., 11 April, 7.15 p.m.
NEWCASTLE UPON TYNE
"Modern Welding Processes," by J. A. Lucey. North East Branch. Roadway House, Oxford Street, Newcastle upon Tyne. Thurs., 13 April, 7 p.m.

Institution of Production Engineers

LIVERPOOL
"Principles of Materials Handling," by L. J. Hoefkins. Liverpool Graduate Section. Stork Hotel, Queen's Square, Liverpool 1. Thurs., 6 April, 7.30 p.m.

Junior Institution of Engineers

LONDON
Films: "Railway Electrification at Industrial Frequency," "Report on Modernisation," "The First A. C. Railway Electrification in India," and "Power to the Pantograph." Fri., 7 April, 7 p.m.*

Leeds Metallurgical Society

LEEDS
"Some Aspects of the Metallurgy of Fasteners," by R. J. Allsop. University Staff House, University Road, Leeds. Wed., 12 April, 6.30 p.m.*

Pipeline Industries Guild

LONDON
Annual General Meeting. Caxton Hall, off Victoria Street, SW1. Tues., 11 April, 6.30 p.m.

Reinforced Concrete Association

BRISTOL
"Ready Mixed Concrete," by Victor S. Wigmore. West of England Branch. New School of Engineering, The University, Bristol. Thurs., 6 April, 6 p.m.*

Royal Aeronautical Society

LONDON
"Development of Stabilising Equipment," by P. D. MacMahon. Fri., 7 April. (*Postponed.*)
"A Quiz on Little-Known Early Aircraft": Discussion. Historical Group. Mon., 10 April, 7 p.m.
"Direct Electrical Power Generation by Thermal and Chemical Means," by Professor M. W. Thring. Tues., 11 April, 7 p.m.
"Man-Powered Flight: Progress to Date," by B. S. Shenstone. Graduates and Students Section. Wed., 12 April, 7.30 p.m.

Royal Society of Arts

LONDON
"The Commonwealth Association in Theory and Practice," by J. D. Bruce Miller. Sir Thomas Holland Memorial Lecture. Thurs., 13 April, 5.15 p.m.*

Society of Instrument Technology

BIRMINGHAM.
Annual General Meeting. Midland Section. Gosta Green College of Technology, Aston Street, Birmingham. Fri., 14 April, 7 p.m.*
MANCHESTER
"Industrial Applications of Television": Discussion. Manchester Section. Nag's Head, Jacksons Row, Manchester. Mon., 10 April, 6.45 p.m.

Television Society

LONDON
"Transparent Phosphor Screens," by Dr. D. E. N. King. Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, WC2. Fri., 14 April, 7 p.m.

West of Scotland Iron and Steel Institute

GLASGOW
"Heating and Oxidation in the Basic Open-Hearth Process," by I. M. Mackenzie, D. Hadfield, T. Urie and Mrs. A. Donald. Annual General Meeting. Fri., 14 April, 6.45 p.m.

Women's Engineering Society

LONDON
"Road Research," by Miss A. Sabey. London Branch. Hope House, 45 Great Peter Street, SW1. Wed., 12 April, 7 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
Building Centre, 26 Store Street, London, WC1. (MUSeum 5400)
East Midlands Metallurgical Society. Apply to Mr. E. D. Knights, 10 Penrhyn Avenue, Derby. (Derby 23307)
Illuminating Engineering Society, 32 Victoria Street, London, SW1. (ABBey 5215)
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Metals, 17 Belgrave Square, London, SW1. (BELgravia 3291)
Institute of Motor Industry, 40 Queen's Gate, London, SW7. (KNIghtsbridge 7632)
Institute of Road Transport Engineers, 1 Cromwell Place, South Kensington, London, S.W.7. (KENsington, 3744)
Institution of Chemical Engineers, 16 Belgrave Square, London, SW1. (BELgravia 3647)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Inspection, 28 Victoria Street, London, SW1. (ABBey 3794)
Institution of Engineers-in-Charge, 13, Grange Close, Edgware, Middlesex. (MILl Hill 3543)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
Leeds Metallurgical Society. Apply to Dr. P. R. Beeley, The University, Leeds.
Pipeline Industries Guild, 7 Iddesleigh House, Caxton Street, London, SW1. (ABBey 6925)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Aeronautical Society, 4 Hamilton Place, London, W1. (GROsvenor 3515)
Royal Society of Arts, John Adam Street, Adelphi, London, WC2. (TRAfalgar 2366)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)
Television Society, 166 Shaftesbury Avenue, London, WC2. (TEMple Bar 3330)
West of Scotland Iron and Steel Institute, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)
Women's Engineering Society, 25 Foubert's Place, London, W1. (GERrard 5212)

Rock-Fill Dam on the Rio Grande

The 1200 MW hydro-electric project on the Rio Grande in Brazil is the largest power scheme in Latin America. The main dam, a rock-filled structure, is now 200 ft above its deepest foundation level and the whole of the flow is being taken by the diversion tunnels that were opened in March, 1960. Construction work is being undertaken by Companhia Anglo-Brasileira de Construcoes (CAB), a company formed jointly by the British firm of George Wimpey and Company Limited of London and Brazilian Cia Constructora Nacional, S.A. The British firm, well known as civil engineering contractors, have had considerable experience in building rock-filled dams, and they now also have an active mechanical and electrical division.

By February, 1960, the tunnels and cofferdams necessary to divert the river were nearing completion and, in the following month, the tunnels were opened so that the river could be shared between the tunnels and a channel that had been cut along the right bank of the river, enabling work to start on the task of dewatering the main dam foundation. Running across the dam site was a natural deep channel in which the depth of water reached 90 ft. This channel was dewatered in April of last year, and cleaning up the dam foundation was well underway when, in May, the diversion channel was closed and the whole flow forced through the tunnels.

Placing the clay core began in July, though in the deep channel this work could not begin until three months later because of the extra foundation preparation required. By the end of 1960 the clay core had been raised 200 ft above the bottom level and filling for the dam itself was proceeding at a rate of 900,000 cu. yd per month, in an effort to raise the crest of the first section to a level safe against over-topping by the flood flow of the first three months of 1961.

Concurrently with the river works, excavations were being made for the foundations of the major concrete structures.

Partial diversion of the river was made during the high flood season, when it would not have been possible to put the whole of the river into the tunnels without the construction of an uneconomically high cofferdam—and larger tunnels. Accordingly, for two months, the river was split between the tunnels and the temporary channel until the floods were safely passed. The site chosen for the final closing of the river was a gap 100 ft wide near to the right bank where the water was relatively shallow with a rock bed and a rock buff on the opposite bank.

The gap was closed in 22 hours, principally by dropping into the stream concrete blocks, averaging 11 cu. yd, wire roped together in groups of five and six. In the final stages, with the stream making 12 mph, this barrier was supplemented by sausage-shaped wire baskets about 6 ft long filled with rock.

Most of the dam foundation is in relatively shallow water except for the deep natural channel which had been caused by a geological fault. The bed of the channel was covered by a thick layer of sand and boulders and dewatering was considerably hindered by the fissured nature of the rock. A number of concrete plugs had to be injected into caves in the walls of the channel. Despite heavy pumping operations, it was not possible to get the water right down before clearing away sand and boulders from the bottom was begun with 4 cu. yd draglines. After the channel had eventually been dried, it was necessary to keep six 12 in pumps working to deal with the seepage that continued to come through the fissured rock.

The dam covers an area of 16,000 sq. yd and the rock on which the clay core rests was hand cleaned and slush grouted. A grout curtain was also sunk 100 ft below the dam foundation level. Where the clay core crossed the deep channel, trenches were cut into the walls to key the clay and, across the invert, a concrete slab was poured through which the grout injection was made prior to placing the core.

With the dam now in full construction rock fill continued to be transported into the site at a rate of nearly 1,000,000 cu. yd per month.

£9 Million Freight Modernisation Scheme at Sheffield

The Eastern Region of British Railways is to start on a comprehensive freight modernisation scheme in the Sheffield area. Costing £9 million, the work is expected to begin in the spring of this year and to be completed by the end of 1964. Railway operations now carried out in eleven marshalling yards, four goods yards and five motive power depots will be concentrated into one diesel depot and marshalling yard at Tinsley and a freight depot at Grimesthorpe.

At present traffic densities, an average of 260 trains will pass through the area each day and 5,000 wagons will require marshalling in the same period. The new yard will be of the most modern type, fully capable of sorting wagons quickly for the 130 destinations catered for. To meet these requirements, both a main yard of 48 sorting sidings and a complementary secondary yard of 26 sidings will be built. Both yards will feed the sorting sidings through humps over which the wagons will be gravitated. Retarding apparatus will provide two-stage fully automatic braking in the main yard. Single stage retardation will be installed in the secondary yard. The yards will be lighted by colour-corrected vapour lamps and two-way radio-telephone communications will be available between shunting locomotive crews and the yard staff. A loudspeaker address system will also be installed.

The advantages of the new layout can be summarised as follows:

A substantial reduction in the number of railway installations in the area—the result will be about a third of the existing.

Rationalisation of the yard facilities that will eliminate double handling of wagons and concentrations of wagons at loading points, thus improving travelling times.

Elimination of train delays and shunting, so improving the service.

Speed-up of transit traffic through the Sheffield area to and from areas as remote as London, South Wales and Tyneside.

Savings that are of the order of 900 staff, 2,725 wagons, 27 shunting and trip locomotives. Operational savings are estimated to amount to £950,000 per annum.

Severn Bridge Contract Awarded

The first contract for the Severn Road Bridge, a suspension bridge, covering the main piers and their foundations, anchorages for the cables, an approach viaduct and site access road, has been awarded to John Howard and Company Limited of London. This is the same company who have just completed the corresponding work on the new Forth road bridge. As the ACD Company are the nominated contractors for steel superstructure in both cases, the combination will have been responsible for the construction of the two longest span bridges outside the United States of America. The Severn is a little shorter than the Forth, 3,240 ft for the main span against 3,300 ft, and the side spans are also shorter, 1,000 ft as against 1,340 ft at the Forth.

The Ministry of Transport announcement of the contract gives the price as just over £1¾ million. The announcement from Howard's details the work to be undertaken as follows:

Two piers, founded on rock, approximately 140 ft by 42 ft by 63 ft high, including deep excavation below water level to bedrock.

Cable anchorages, which will be two massive concrete blocks, 163 ft by 123 ft by 150 ft, including the embedded steelwork for resisting the pull in the two main bridge cables.

A viaduct at Aust, at the east end of the bridge, comprising three spans having a combined length of 513 ft.

A breakwater at Beachley to facilitate ferry berthing during the construction of the bridge.

Work in the River Severn is likely to present some unusual problems for the contractors. The tide at this spot rises and falls more than 40 ft and the current runs anything up to 9 knots. Consequently, the restrictions imposed include short working time between tides, difficulty in mooring vessels where required, and severe conditions for temporary works. Experience gained in the Firth of Forth will help the contractor.

The most important difference between the Severn and Forth bridges is to be seen in the anchorages. At the Severn mass concrete structures, relying on their weight and shear resistance at ground level, form the anchorages. At the Forth bridge the anchorages are underground in 200 ft long concrete-filled tunnels driven at 30° inclination into the rock. Another apparent difference, judging from the sketches released, is in the main suspenders. In both bridges they consist of four-part ropes falling from bands on the cables, At the Forth all four parts fall vertically to a single panel point on the main deck trusses; at the Severn, however, the ropes of the suspenders will be inclined, with the main panel points of the trusses midway between the cable nodes, two of the parts falling one way and two the other. Unless some means of adjustment is incorporated at deck level—there is none at the Forth—the suspender maker will be faced with a very difficult task cutting the ropes to length. Also at the Forth, cross bracing is used between the legs of the towers, whereas heavy horizontal cross members appear to have been adopted for the Severn.

The schemes for the new bridge and the associated approaches have been prepared by Mott, Hay and Anderson in conjunction with Freeman, Fox and Partners, both of London, and Sir Percy Thomas as consulting architect.

The issued sketch of the Severn Bridge.

Adaptable Support For Services

An immense problem had to be faced in supporting services in the new Shell Centre being built on London's South Bank for the Shell International Petroleum Company Limited; the principal building in the Centre is a 26 storey office block.

In addition to the thousands of lighting fittings, there is a pneumatic intercommunication system,

The Unistrut walkway construction above the false ceiling supports, giving easy access to the cable trays.

drainage, services for the kitchens, restaurants and a cinema/theatre, an extensive sprinkler system, as well as air conditioning and heating systems. The services had to be readily accessible for maintenance and the support method adopted had to avoid the expenditure involved in conventional methods.

Extensive use of Unistruts eliminated much of the drawing office work normally necessary to pinpoint the position of each support, the fixing of the supports to the structure and cutting, bending and drilling of angle iron. Altogether, nearly 50 miles of Unistrut steel channel support system, made by the Unistrut division of Sankey-Sheldon of Welwyn Garden City, have been erected in the Centre. Channel insets were built into all the structural ceilings and some of the walls so that supports could be suspended in any position. The flush slot formed by the channel allowed complete freedom of fixing for the spring-loaded nut and bolt assemblies, and pipes and cables can be clipped in, removed or changed without disturbing any other service.

"Rammed" Through Underpasses

On the basis of experience gained in driving prefabricated pedestrian passages through railway embankments using reinforced concrete tubes, German contractors have extended the practice to traffic underpasses involving road widths of 40 ft and traffic clearance heights of 14 ft built into embankments 45 ft wide.

The side walls of the underpass are built adjacent to the embankment and in alignment with their final position. Beyond them, a rigid back structure is constructed and each wall is driven through the embankment by hydraulic jacks mounted between ends of the wall and the back structure. To ease driving, the wall sections are fitted with temporary cutting noses. After the walls are in position, the soffit members are similarly driven into position, the dumpling excavated and the invert constructed.

For an underpass of the size mentioned above, thrusts of about 1,000 tons were required to push each wall through the embankment. No problem was met in correctly locating the walls, which were described as being "almost exactly parallel." The maximum deviation from the perpendicular was 1¾ in. (*European Technical Digest No. 4006*)

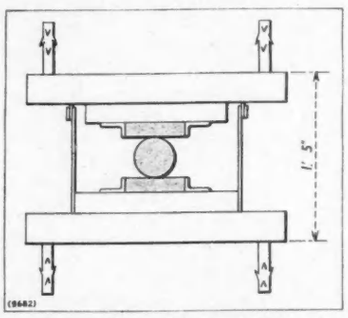
High Speed Shaft Sinking

An all-time British record for shaft sinking was set up at Kellingley Colliery in the North Eastern Division of the National Coal Board, when 339 ft of completed shaft sinking was achieved in the callendar month of January this year. The best previous figure was obtained a Parkside Colliery in 1959 with 310 ft in a month.

Kellingley is the first completely new project, expected to cost £8 million, planned by the board in the division, and when full production is reached (by October, 1964) about 6,000 tons of saleable coal will be raised each day.

High Capacity Bridge Bearing

A new high load capacity bridge bearing, made of high tensile steel, is being made and marketed by Joseph Westwood and Company Limited of Napier Yard, Millwall, London, E14. Known as "Hi-load" bearings, they are claimed to be able to sustain a load many times greater



600 ton Hi-load bridge bearing.

than that previously used for single rollers in this country.

The bearing, as shown in the illustration, comprises a single roller of 4 in diameter contained within two plates, all made of heat treated alloy steel. Independent tests have shown that the bearings can carry 65 tons per inch of roller without evidence of surface cracking and without undue permanent distortion. On this basis, a working load of 25 tons per inch is acceptable, as compared with 2 tons per inch for mild steel and 2·8 tons per inch for common high tensile steels for the same diameter of roller. The sketch is dimensioned for a bearing able to take 600 tons.

When required for use on steel bridges and piers, the outer top and bottom plates can be omitted, resulting in an even shallower unit.

Cement in Road Bases

The Ministry of Transport has been specifying "cement bound granular base material" on selected projects, including motorways, and some confusion has occurred between this material and lean concrete. To explain the position, the Cement and Concrete Association (52 Grosvenor Gardens, London, SW1) have issued a small booklet (*gratis* on application).

Lean concrete, as a base for bituminous surfaces, was introduced about ten years ago. Cement to aggregate ratios of about 1 to 12 were used with normal concrete aggregates and mixing was done in normal mixers; the material was spread by hand and compacted by rolling, often with vibrating rollers. Experience showed that even less cement was required and Ministry specifications called for one part of cement to either 15 to 20 parts of gravel or 18 to 24 parts of other aggregates (such as igneous rocks and limestones). Generally no difficulty was found with working the mix but when there was more than 45 per cent fines it was sometimes found that mixing took an excessive time or could not be completed in conventional machines; this difficulty, however, was overcome in pan type or paddle type mixers or in pugmills. The significant point about lean concrete was that the aggregate was selected to the same standards as were used for high strength concretes.

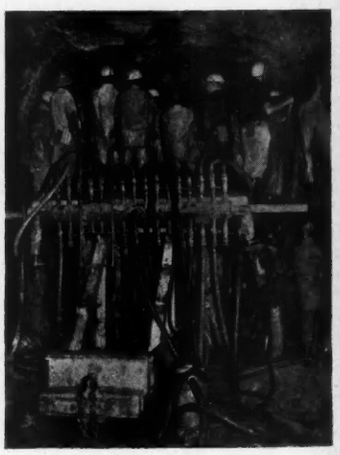
More recently however, road projects have been planned that have happened to be near plentiful supplies of face gravel and all-in ballast. Work was therefore put in hand by the Road Research Laboratory and the Cement and Concrete Association to see if this material could be used, though it was variable and "dirty." Experiment showed that it could be used satisfactorily so long as mixing was thorough. Concretes so made were denoted "cement bound granular base materials."

The mixes are the same as for lean concretes and the properties are similar. Mixing cannot be carried out in free-fall mixers because of the high fines content and a higher (8 per cent) water to dry materials ratio is required. With a dry density corresponding to 5 per cent air voids the material will give compressive strengths in the range of 500 to 1,200 lb per sq. in.

For the majority of jobs, lean concrete will be more suitable because mixing can generally be done in standard plant, but on larger contracts or where special mixers are available the cheaper material may be preferred.

High Speed Haulageway Construction

During a 26 day period last year at the Nchanga Consolidated Copper Mines a new 14 ft square haulageway was advanced through hard rock at a daily average of 47 ft and a total of 8,889 cu. yd of rock was excavated in that time.



Batches of Holman Handrils and Airlegs at work in the haulageway.

Operations were organised in six hour shifts and, on one occasion, two whole cycles of drilling, firing and clearing were completed in one shift. Drilling was done with Holman HA300 Handrils, eleven being in use and seven standing by, and a similar number of Airlegs. Tungsten carbide 1 in hexagon steels with integral chisel bits were used. The Handrils, working at a pressure of 100 lb per sq. in, were used to drill an 8 ft 9 in round, and five to six rounds were drilled every 24 hours. Each round was cleaned in one operation using conveyors which enabled the rock to be loaded away without any shunting operations being required.

Human Element

Management Consultants Neo-Organisation Men?

Is the management consultant a later version of William Whyte's Organisation Man? Mr. Frederick Erroll, Minister of State at the Board of Trade, speaking at the lunch marking the opening of the European Conference for Management Consultants in London, thought it fair to say the consultants were a well known variety of "the genus neo-Organisation Man."

In this he saw something of the admiration universally accorded the man who can get the most out of things. Mr. Erroll followed up the point that the British have an inborn respect for the man who gets the most out of things and can make a little go a long way.

In Britain the population was at once too big and too small. Too big for us to live off our own natural resources. Too small for us to use labour extravagantly or cheaply. The nation's living is earned by the exercise of highly trained skills. In banking houses or shipping lines the factors of work study, cost control and personnel management are as pressing as they are to the manufacturing concern. On the factory floor incentive schemes may be as important as an economic layout, and both as significant as the very latest plant.

The £5 million spent by British companies last year on consultancy services struck Mr. Erroll as an impressive figure, but he believed that industry could profitably spend even more in making certain that its production and marketing techniques were in all respects up to date and effective.

First of the modern management consultants was the American Frederick Winslow Taylor who started out in 1893. On his first card he wrote "Consulting Engineer, systematising shop management and manufacturing costs a speciality." His charge was $35 a day, subsequently increased to $40.

Mr. W. Coutts Donald, managing director of Urwick, Orr and Partners and chairman of the Management Consultants Association, in his talk on the history, ethics and policy of consultancy, observed that much of the criticism of the cost of consultancy arises from comparison of unlikes. The comparison is often made between the consultant's fee and the salary that would be paid to a man of equal ability to the consultant. The fallacy in this is that an employee's salary is only part of the cost to the employer, in addition the costs of supervision and travelling are included by some consultants.

It is worth adding, too, that the consultant by his very freedom from close identification with the client is providing quite different service to that possible from the committed, on-the-staff, individual.

Management consultancy as an organised business made its debut in the United Kingdom in 1926 when an American company set up a subsidiary. Conservative business men behaved with normal caution. The unions were suspicious. For all that there was a steady growth in demand for consultancy services.

The really rapid expansion followed the Second World War. Most recently operational research, automatic data processing, control engineering have joined the long list of new activities in which consultants are assisting industry. An additional field which some of the larger consulting companies have entered is management teaching, a subject on which the British universities are not particularly enthusiastic.

The most recent figures show 1,100 consultants working for member firms of the Management Consultants Association. Beyond the United Kingdom home industry, British based consultants are working in Europe, the USA, Canada, Australia, New Zealand, Asia, Africa, India and Central and South America.

Urwick, Orr's managing director described management consultancy as being fundamentally concerned with four subjects. These were:

Techniques for analysing and measuring tasks, and improving methods of performing them.

Skill in adjusting individuals to those tasks.

Arranging and correlating tasks, organisation and techniques of special functions such as marketing, control and purchasing.

Motivating and integrating groups —leadership, morale, communication, industrial relations, public relations and so on.

Since it is obvious enough that the majority of managers cannot have mastered the whole field laid out here, the need for the consultant becomes plain.

Blue Streak Cost £86 Million Plus

Replying to a question in the House of Commons, Mr. Peter Thorneycroft, the Minister of Aviation, has stated that the cost of the Blue Streak military project up to the date of cancellation was £84 million. Keeping open the peaceful launcher project as a useful possibility has cost £2·5 million up to the end of February. Including the maintenance of the Spadeadam installation, maintenance costs were now running at between £300,000 and £350,000 a month.

To a further question, whether the project was worth going ahead with at all, Mr. Thorneycroft replied that in matters of this sort there were many fainthearts, but there was a real possibility of something of immense value to Europe emerging. It would be foolish to cast the opportunity aside without exploring every possibility of going forward with it.

Spring Weather Raises Construction Employment

The rapid return to full time working in the vehicle industry is reflected by the final figures of unemployment and vacancies for mid-February issued by the Ministry of Labour.

In the manufacturing industries the number of unemployed declined by 12,800, including 11,000 workers who had been temporarily idle. The largest single reduction was in the car industry where in the month up to 16 February the number stopped fell by 14,200, of whom 13,800 had been temporarily out of their jobs. In the whole Ministry of Labour table the only category in which the labour force fell from mid-January to mid-February was in shipbuilding and marine engineering.

In the shipyards 1,023 workers became wholly or temporarily unemployed during the month.

Unfilled vacancies rose substantially in number in the period from 12 January to 8 February. Vacancies in the manufacturing industries rose by 1,800. There were 2,100 more jobs available in construction, 1,000 in transport and communication, and 1,900 in miscellaneous services, which included 700 in catering and hotels.

The mild weather helped to make some employment alterations varying markedly from the normal seasonal changes. In construction there is usually in this period a fall in unemployment of about 1,400. This year the number in employment rose by more than four times as many—5,700.

The normal seasonal drop of 2,000 in the labour force of the manufacturing industries has been reversed to an increase of 1,800.

Rising Accident Rate in Building

In the past seven years one man in ten in the construction industries has suffered serious injury, and in the last six years one in a thousand has been killed.

Describing the accident situation in the building industry as a "distressing and melancholy picture" Mr. Peter Thomas, Parliamentary Secretary to the Ministry of Labour, told the recent annual dinner of the London Building and Engineering Constructors' Accident Prevention Group that the casualty figures for last year were the highest on record.

There were 20,596 reported accidents during the year, more than 2,000 above the reported accidents of 1959. Deaths were up by 65. Mr. Thomas took this as illustrating the point that more could be done and must be done for the successful tackling of the problem.

From all premises to which the Factories Acts apply, the reported accidents last year amounted to 190,000, an increase over the previous year of almost 16,000. Deaths were 665, another increase—by 67. The British Productivity Council calculates that the loss to industry generally was 19 million man-days, and some £100 million in lost production.

There is no doubt that very many building and constructional firms are making genuine efforts to make their workers more safety conscious. At another level, codes of safety regulations covering the construction industries as a whole for the first time are in the course of preparation. It is hoped that when these regulations are in force, compliance with what will amount to a comprehensive set of safety provisions will assist in reducing the current accident toll.

Mr. Thomas emphasised to the Accident Prevention Group that by their nature safety regulations were only minimum requirements. For safety in industry to be achieved there had to be a clear realisation by all working in it, whether employer or employee, that they had a personal responsibility for improving standards.

The Parliamentary Secretary stated plainly that while there are firms in the construction industries with an outstandingly good safety record, there are still not enough of them. It was too easy in this field for the work and responsibility to be left to a few enthusiasts who were prepared to spend the time and money in pursuit of higher safety standards.

Nothing So Precious as Your Eyes

A serious eye injury can be so disastrous to the sufferer that no personal effort or precaution is too great for the elimination or reduction of risks, yet in 1959 Chief Inspector of Factories Report listed almost 7,000 eye injuries of varying nature and severity.

A great deal is already being done with posters, lectures and so on to emphasise ways of avoiding danger to the eyes and a new weapon in the armoury has just appeared—the eight minute 16 mm sound and colour film, "Your Eyes are Precious."

The film, produced by the British Steel Founders Association through its safety committee, deals in particular with situations likely to be found in steel foundries, but its general theme is broadly applicable to all industry. The film comes down effectively for the continuous wearing of goggles or eye shields, on the importance of obtaining skilled treatment for any injury to the eye and on the consequences of neglect.

Copies of the film are available on loan from the British Steel Founders' Association office, in Sheffield, and copies of the film can be bought from the Association for £15 each.

Electrical Wiring and Restrictive Practices Court

The British Standards Institution's Consumer Advisory Council is assisting the Registrar of the Restrictive Practices Court in the collection of information on householders' experiences of electrical contracting work.

This follows the reference to the court of the National Federated Electrical Association's agreement recommending the margins to be added by electrical contractors to their costs.

The Council would like householders who have had recent additions or replacements to electrical wiring to send details to their headquarters, Orchard House, Orchard Street, London W1. Details of interest to the Council include:

Type of work.

Whether estimates were obtained in advance.

Basis on which the work was priced—time and materials, or fixed price for whole job.

Comments about work or prices.

Tests for Yachtsmen to be Considered

A seamanship test for the owners of yachts and small boats is to be considered by the Ministry of Transport.

Complaints of lack of skill, and sometimes of lack of regard for safety, are heard around the coasts and the increasingly crowded rivers from soon after Easter. The popularity of outboard motors, and their steadily growing power, is perhaps making the problem more urgent by giving amateurs the ability to get into trouble much more quickly and much further from land.

The First Two Years After Graduation

Whether a man is a brilliant scholar or a plodder, the first two years after graduation are likely to be critical in his future development as an engineer.

By the time a man has graduated in mechanical science or a branch of engineering, he has already lived about a third of his allotted span, he has passed the age of maturity by several years and it is perhaps ten years since it was desirable for him to be acquainted with the facts of life. By any reckoning he is a man, but he has not been allowed to show what he can do to earn his living or contribute to the nation's economy. That miracle computer which is his brain has been programmed—has been stuffed with knowledge and facts—to an extent that is not likely to be repeated again in his lifetime, and for having put that behind him he can heave a justifiable sigh of relief.

For nearly twenty years the education machine has assessed his talents at every turn. His teachers have repeatedly compared him with his class-mates. His parents, vainly trying to pretend a disinterested attitude, have watched his performance anxiously.

As he crosses the watershed after that long stiff climb up the educational slopes, how does he feel? He has been accustomed to climbing in clear weather, always able to see the ridge that is his university degree, but now the rough country ahead will always be covered in mist. An awful lot will depend on his first two years.

QUESTIONS

At one time fathers paid premiums for their sons to be trained as engineers. The son of the 1960's is likely to look coolly at a firm's recruitment officer and ask two simple questions: "Will your scheme qualify me for corporate membership of the Institution, and what will you pay me?" These are relevant questions, but they are not the whole story. There are other things to decide. Should he go to a big firm, a medium size firm, or a small one where perhaps he will not be treated as one of a crowd? Should he go to a long-established engineering industry, to one of the new, up-and-coming industries, or to a non-engineering industry where engineers can make a significant contribution? The training the graduate will be exposed to, with the company he eventually decides to join, will depend on which side of a current controversy the management have elected to support.

For a long time the fashionable idea has been to take the young graduate, enter every detail of his scholastic and extra-curricula attainments in the records, and attach him with clockwork precision to a series of departments in turn. The result can be disastrous. Left to himself by a shop manager, who anyway believes that no member of the management knows or cares what happens in his department so long as the schedule is adhered to, the graduate newly arrived in industry can find himself bored, suspicious of the rightness of his decision, and perhaps heading for the corner in the canteen where the other graduate trainees are swopping stories about the startling success of colleagues in other firms.

The grapevine first set up in college will faithfully transmit the usual information on the greenness of the grass on the other side. It rarely reports that in X Company, the graduates there as also sitting around.

There is another way of assisting the take-off of the graduate of outstanding attainments who has opted for industry rather than accepting that proffered post on the staff of the college. It is almost certain that, in addition to the prospects of glittering reward, one of the reasons for his decision has been that he wants to do a job, to construct, to get results.

Ultimately the best of those rewards are going only to the men who can get results, in a situation where others would spend the company into bankruptcy, or more simply give up. So, runs the argument of certain firms, let the graduate start work right away, on a project, assisting a manager, with results to be produced that are capable of assessment and with responsibilities that tie in directly to the factory's job of turning out a product, at a profit. This way the graduate of parts has much less chance of frustration, he has a full chance to show his abilities, and there is always a bigger and tougher job to move on to in a few months' time.

There are no simple answers to these questions. The big firms, and some of the others, have organised their graduate training schemes, but it depends to a large extent on the man himself whether his personality develops in the right directions during the first two years. In some cases a man has actually benefitted from an indifferent attitude to trainees if this indifference has provoked him into protesting action. On the other hand, if he allows himself to become browned off, and sulks through his training period, he may turn out to be one of those tragic cases—a man with a promising past.

A man with a brilliant academic record runs this risk more than one who has done moderately well. His ambition has been fired, and his hopes built up, by the repeated signs from his teachers that he is blessed with exceptional powers. He has grown accustomed to the grandeur of the top position, and when he finds he cannot automatically maintain it in the cruel world, he is in danger of collapsing under the, to him, devastating humiliation.

In some ways the man whose ability is only average is at an advantage. No one has ever told him that he has an exceptional opportunity because of his prowess in examinations. He has usually been told that he could do better if he tried. To him, now is the time to try. He can take the rebuffs of the first two years because he is used to taking slightly disparaging remarks. If because of his modest talents at school and university he paid more attention to games and sports than his father would have liked, the chances are that he is perfectly at home in company and knows how to talk to people, whether for social or ulterior motives. He may go far.

THE REBEL

The man of inferior attainments starts out with almost insuperable obstacles—at any rate if he cherishes secret ambitions to become the managing director. Of course he may elect to stay in a fairly hum-drum job all his life (the advantage of this approach is that at retiring age he can always comfort himself with the thought that he has achieved what he set out to achieve). But his real trouble is that he has been told so often, directly or indirectly, that he hasn't a cat in hell's chance, he may have come to accept this verdict of the educational pundits. There is just a slim chance, however, that he may rebel against this verdict. Whatever his intellectual shortcomings, he may have the common sense to realise that the schoolmasters are somewhat biassed in favour of examination results. Unfortunately, the industrial educational machine also weighs the scales against him. There is a universal mesh which screens out the people whose intellects are not fine enough to pass. For him, the only chance is to search around for a firm which will accept him because his face fits. Maybe he can find one where the managing director or the chief engineer is a man who started out in life with a similar discouragement. There are such firms, if he can find one. These gentlemen are often called upon to give away the prizes at school speech days. A carefully worded letter to one or two of them might pull it off. And if our below-average friend can pull it off in the first two years, he will soon become a legend—the man who failed this and that but is now the managing director's personal assistant—a source of encouragement to yet another generation of near-hopeless cases, and probably very good value at a party or other social occasion.

ON THE SHOP FLOOR

In perhaps 80 per cent of cases the graduate goes up to university straight from school. Some elect to have a year in industry first, sandwiching this brief industrial spell between the dictatorship of school life and the liberal atmosphere of university. These fellows reap one important benefit. The man on the shop floor—the fitter, turner, welder, moulder—will talk to him more freely than to a university product. He will adopt a fatherly attitude towards the boy straight from school, whereas there is a barrier between him and the man who has spent three years taking a degree. Thus the boy of 17, 18 or 19, though he may be slightly alarmed by the crudity and toughness of works life, finds that among the craftsmen there are some splendid characters, who will teach him more of human nature—and hence of management problems—than the solely academic types will ever learn if they live to be a hundred.

He may not appreciate this point at the time, while he is doing his spell in the shops (there will be plenty of people to tell him he is wasting the best years of his life), but later on, when he has mixed with all sorts and conditions of men, he will realise that that was the most formative period of his career. As he had been allowed to make his own way in his first few years as a child at school, so now he is allowed to find his feet in his first few years in industry. In contrast to the attitude adopted towards the man who graduates before putting his nose inside a workshop, he is not expected to perform miracles on the strength of his academic record. In fact no one expects very much from him at all. So long as he clocks in and behaves himself, there are no complaints.

One of the shop-floor men, showing him the "secrets" of craftsmanship, will probably remark "One of these days I suppose you'll be a boss and use all this knowledge you're picking up against us." He won't know what to say to that—not having been a boss—but the remark will stick in his memory and probably trouble him years later when he is sitting in an office chair thinking out one of management's problems. He will be a better engineer for having had this experience, because he will realise that the function of management is not the divine right of superior beings but the job of men with deep understanding.

HIGHEST POSTS

It is during the first two years after graduation that the habit of trying to understand the human problems of engineering can be acquired or rejected. If a man rejects it, he is inevitably limiting his powers to develop in the future. He may argue that engineering is solely a technical matter, and that everyone should bow to the inevitableness of technical progress. Perhaps they should, but they don't. If on the other hand he humbly tries to acquire this habit of human understanding, he will qualify for the highest posts in the profession.

Thus the question of how to spend the first two years after graduation can only be answered after considering what, if any, industrial experience has already been acquired. If the answer is none, then a man would be well advised to embark on training that will make up for this lack. At the same time he can ensure that his training will be acceptable to the requirements of the Institution which he wishes to join.

As for salary—what does it matter compared with his earning powers for the rest of his career?

STABILISED POWER SUPPLY

Variable Output

THE latest addition to the Altron range of power supply units is the model EV451-A illustrated.

This is a portable unit measuring 12½ in by 11 in by 8½ in overall. It will provide fixed and variable dc outputs of 200 V and 0 to 300 V respectively in addition to a heater supply of 6·3 V ac rated for a current of 3 A.

The variable supply may be adjusted to any voltage in the range from 0 to 300 V and both coarse and fine controls are included. It will deliver an output up to 50 mA at any voltage between 0 and 250 V.

The stability of the output voltage of the unit when measured about the set point is better than ± 0·015 per cent for changes in mains supply of ± 10 per cent and all current values from no load to full load. The internal resistance of the supply is less than 0·25 ohms and the impedance less than 2 ohms up to 50 kc/s. A volt meter and ammeter are permanently connected in the variable supply output line so that continuous metering is obtained.

The maximum ripple voltage is 1 mV rms under all conditions. Currents up to 8 mA may be drawn from the fixed 200 V supply, the characteristics of which are otherwise the same as for the variable supply. The two dc supplies are brought out to three terminals, the fixed supply being negative and the variable supply positive, both with respect to the common terminal, and as both supplies are isolated from earth the unit may be used to produce a low current (from 0 to 8 mA) supply of 0 to ± 500 V dc, by suitable connection to the load. *Allied Electronics Limited, 28 Upper Richmond Road, Putney, London, SW15.*

LOADING CRANE

For Commercial Vehicles

A NEW version of the Lorry Loader crane, now on the market, is quicker in operation and more flexible than the earlier model.

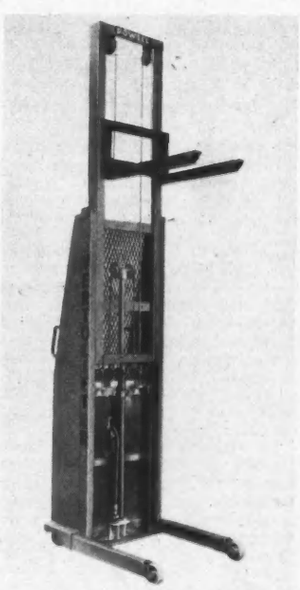
The Mark II crane is hydraulically operated and has an articulated jib for improved flexibility. The jib is operated by a double acting ram applied to the point of articulation and in addition has a telescopic extension member, worked manually, which gives the crane a maximum outreach of 11 ft 2 in. The maximum lifting capacity at a radius of 5 ft 5 in is 1 ton, reduced to 7 cwt at the maximum extension distance.

An oil pump fitted to the vehicle gearbox power take-off provides the hydraulic power for the crane. Operation is under the control of three levers which may be moved separately or simultaneously to impart the various motions to the crane.

The usual mounting for the crane pillar is on the left of the vehicle, the chassis of which is suitably reinforced by the addition of mounting plates and cross bracing. A hydraulic support leg is provided to take the strain from the chassis when the crane is handling loads. A short or long pillar can be fitted to suit the vehicle requirements and the space needed between the body and the driver's cab is from 14 in to 17 in. *R. H. Neal and Company Limited, Grantham.*

STACKING TRUCK

Very High Lifts



A NEW Vertolifter truck has been introduced for conditions requiring high stacking.

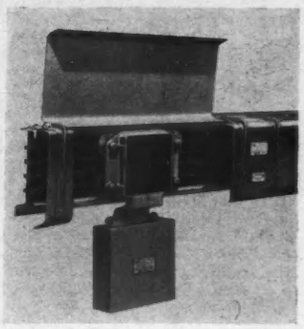
The truck is designed for lifting light loads at high speeds and two standard models are available with lifts of 120 in and 148 in respectively. Loads up to 350 lb can be handled by either and the lifting speed is up to 26 ft per minute. The twin forks in the standard machines are 24 in long and a detachable platform can be fitted if required.

Lowered, the heights of the two trucks are 74½ in and 88½ in respectively, so that both models can negotiate normal doorways. A special application is for basements where headroom is restricted and the loads have to be lifted through hatches to first-floor levels.

The hydraulic ram is powered by a battery or by a three phase or single phase motor running from the mains. A hand-operated variable speed release valve permits safe controlled lowering of the load. *Powell and Company Limited, Burry Port, Carmarthenshire.*

COLLECTOR TRACK

Heavy Current Version



HEAVIER currents can be handled by the Trolleymaster 250 collector track system.

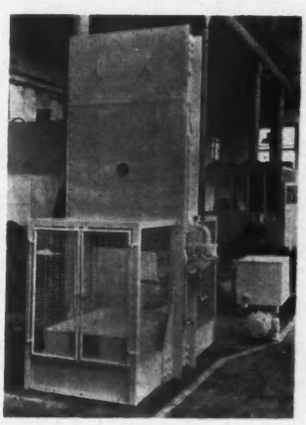
The conductors are suitable for 250A and the mobile trolleys are capable of power requirements up to 150A in the four bar version at present available, with a voltage range up to 600 V ac or dc, that is, for three phase and one earth conductors. Particular attention has been paid to making the components simple for operation and erection under rough conditions, in foundries or outdoors, for example, and for easy maintenance.

The main runners are made of ¼ in mild steel rolled to the required section in 10 ft lengths. Internal spacer brackets are cast in non-ferrous material and have a substantial section. Cover plates are of sheet steel and the brackets are again non-ferrous castings. The insulators are individually moulded in Rosite, and are located within the internal brackets and secured by a removable strap.

The trolley collectors each consist of a non-ferrous casting fitted with four 3 in diameter rollers with shielded ball bearings. The upper pair are located in a recess with a slot on the underside. Spring loaded carbon brushes are used, each being rated for 50-60 A. For higher loadings brushes are connected in parallel. Overall dimensions of the track are 11¼ in by 7 in and the weight is 12 to 14 lb per ft run. *E.M.S. Electrical Products Limited, Common Lane, Kenilworth, Warwickshire.*

SPLITTER

For Bales of Rubber



THE MACHINE illustrated has been designed primarily for splitting bales of raw rubber.

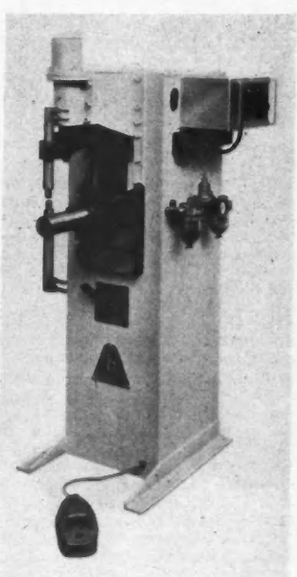
Basically it is a downstroking press with a table, on which the bale is placed, and a blade instead of the usual top die. There is a large baseplate with rolled steel channels bolted to it to form the columns, the tops being tied by a bridge of rolled steel joists welded together.

On the underside of the bridge several double acting rams are positioned and a blade made of 1 in mild steel plate is fitted to the lower end of the rams. The blade runs in guides in the columns and has a renewable cutting edge. The bale is moved under the blade by a traversing table propelled by a hydraulic cylinder. The columns and blade cylinders are encased in sheet metal guards.

The hydraulic cylinders that operate the blade are all banked together and fed from one control valve which is itself banked with the traversing table control valve. Common mains are connected to the separate fixed-delivery pump and motor. The standard machine has a capacity for bales 1 ft 9 in high by 2 ft 3 in wide by 3 ft long with a single blade. Other size machines and a model with two blades are also available. *Sutcliffe Hydraulics Limited, Speedwell Works, Whitwood, Castleford, Yorkshire.*

RESISTANCE WELDER

Spot, Projection and Stitching Actions



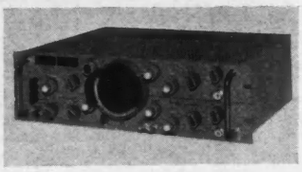
RECENTLY added to the range of resistance welding machines is the model illustrated.

This is a low capacity air-operated machine, with a vertical sliding head and capable of spot, projection and stitch welding. On light gauge material spots can be made at rates up to 250 per minute, the rate varying with the thickness of the material used. Three sizes of the machine are made, rated for 25, 35 and 50 kVA at 50 per cent duty cycle.

The welders are designed to give full tip pressure when working on air at 80 lb per sq. in. The bottom arm is bored at both ends to take an electrode, vertically at one end and at an angle of 20° at the other. Heat regulation is by a 6-stage off-load rotary switch. Operation is from a transformer running from the 400-440 V three phase mains, and a four-stage electronic timer is used to control the welding cycle. *Standard Resistance Welders Limited, Endurance Works, Maypole Fields, Cradley, Staffordshire.*

DOUBLE BEAM OSCILLOSCOPE

Rack Mounted



NOW AVAILABLE is double beam oscilloscope designed for rack mounting. Model CD1016 is very compact, measuring only 5¼ in high by 19 in by 14¼ in overall and weighing 25 lb. It has two identical Y amplifiers, band width of dc to 5 Mc/s (−3 dB), with a rise time of approximately 70 mμsec. Nine sensitivity ranges cover 100 mV/cm to 50 V/cm with ± 5 per cent accuracy In addition, a fine control gives continuous coverage up to approximately. 100 V/cm. The integral ac preamplifier preceding Y2 gives six additional sensitivity ranges with a maximum value of 1 mV/cm. The input impedance is 1 megohm and 30 pF. Inputs may be floated up to 500 V relative to chassis.

The time base covers 1 cm/μsec to 2 cm/sec in 18 calibrated ranges with ± 5 per cent measuring accuracy. A fine control with a calibration position gives continuous coverage to 1 cm/sec. The maximum sweep speed of 5 cm/μsec may be obtained by using the X expansion. The oscillocope may be triggered internally or externally, on TV frame, TV line, auto or normal modes. "Level" and "stability" controls permit accurate and reliable triggering at a selected point on the displayed waveform.

A bootstrap type time base is employed giving a linearity better than 1 per cent. The time base waveform (10 V peak-to-peak) is available at a socket on the front panel.

The X amplifier (bandwidth dc to 750 kc/s) has continuously variable sensitivity from 0·15 V/cm to 1·5 V/cm. Direct access to this amplifier is available for external signals. A 30 V bright-up pulse derived from a separate bi-stable circuit, dc coupled to the cathode ray tube, gives bright displays at all sweep speeds. Provision is made for external brightness modulation. *Solartron Laboratory Instruments Limited, Cox Lane, Chessington, Surrey.*

OFFICE COMMUNICATOR

Comprehensive System

IMMEDIATE two-way loudspeaking contact can be made between positions without dialling with the "Ring Type" Loudspeakerphone.

The system is completely independent of the telephone switchboard. It consists of a number of ten-line master control units with a single common amplifier. A full installation comprises 11 standard units but special models can be supplied if a larger system is required.

A user, by pressing the appropriate button on his master unit, can contact any other unit, or by pressing all the relevant line buttons can contact any number of others simultaneously. The line buttons lock-in when depressed and are released by a cancel button. It is claimed that speech reproduction is extremely clear; the volume can be adjusted by a single control on the fully transistorised common amplifier.

The Loudspeakerphone operates from 200-250 ac mains or from 100-110V ac or from 18 volt batteries. Consumption is 70 watts during operation and 35W during standby. Two fuses in the amplifier give protection against component damage and fire; the line voltage never exceeds 25V dc. Master units measure 12 in by 6¾ in by 9¾ in and are supplied in cream plastic housings with light grey loudspeaker grilles. The amplifier units are 10½ in by 7 in by 14 in with a hammer finish in dark grey and silver grey. *AEI Radio and Electronic Components Division, 155 Charing Cross Road, London, WC2.*

COUPLER

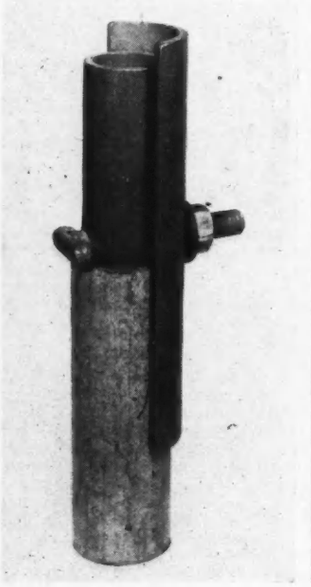
For Standard Scaffold Tubes

SHORTLY to come on the market is a coupler for butt joining scaffold tubes.

The fitting consists of an internal spigot that will slide inside all standard sized scaffold tube and a supporting pressure plate that fits on the outside. A single bolt passes through the spigot and has an enlarged head at one end; this and the protruding shank act as stops for the tubes to be joined, so that the spigot enters each equally. For clarity only one tube is shown in place in the illustration.

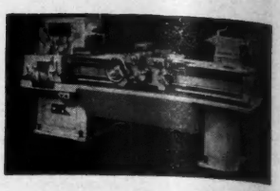
The ribbed clamping plate is made longer than the spigot, so that it will act as an automatic tube register for keeping alignment, and for ease of entering the spigot in the tube. To clamp the coupler, the nut is tightened gripping the two tubes against the spigot and making a firm joint.

The standard finish in which the coupler is supplied is sherardised and the price is low. *Boulton Scaffolding Limited, Booth Street, Birmingham 21.*



CENTRE LATHE

10 in Swing over Slide



RECENTLY added to the Monarch range is a centre lathe with a swing over the slide of 10 in.

The lathe is suitable for toolroom and production use as it combines precision with high rates of metal removal. The height of centres is 8 in and the distance between is 54 in. Power is supplied by a 5 hp motor mounted on an adjustable plate and enclosed within the headstock base. Control is by a forward-stop-reverse push button on the headstock. The drive is through multiple V belts with a heavy duty twin disc clutch and a multiple disc brake which are controlled by dual levers, one on the headstock and the other on the apron.

The headstock has helical constant mesh gearing, speed changes being made by positive multiple jaw clutches giving a range of 16 spindle speeds from 28 to 1,200 rpm. The spindle is mounted in taper roller bearings and is bored 1$\frac{13}{16}$ in. The nose accepts a No. 3 Morse taper centre and has a Camlock 6 in D-1 mounting for chucks and faceplates. The lubrication is combined pump and splash.

The gearbox provides 48 threads and feeds and has provision for cutting non-standard pitches by the use of compound gearing. Thread range is from 1½ to 92 tpi and feed range from 0·0012 to 0·070 in per rev. Leadscrew and feed-shaft cannot be engaged simultaneously. Longitudinal and cross feed drives are through large cone clutches and the rack pinion is worm driven for smoothness. The apron rack is made in 2 ft sections and is hardened. For thread cutting, a large chasing dial is mounted adjacent to the half-nut engaging lever.

The compound slide accepts tool shanks up to ⅝ in by 1⅛ in in the light-house type post. A heavy duty post is also available. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

HAND BANDSAW

Weighs 21 lb

THE "Baby" bandsaw is designed for all general purpose cutting normally carried out with a hacksaw.

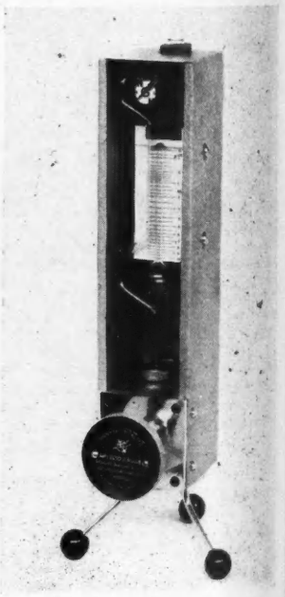
The saw will cut through 1½ in diameter mild steel in 80 seconds without effort, the feed being under its own weight. The drive to the blade is from a built-in ½ hp motor through six hardened helical gears. The blade is guided by two pairs of hardened steel rollers and is kept under constant tension by means of a rack and pinion mechanism. A half-turn of a rotary button releases the tension for blade changes. The high speed steel blades have a long life.

The machine is supplied complete with saw blade and will cut bar up to 2½ in diameter and profiled material up to 4½ in by 3 in. Cutting speed is 115 ft per minute and the motor runs from 220-250V single phase mains. The overall dimensions of the saw are 21½ in by 7½ in by 6¾ in.

Optional extras available include a stand with work table for converting the machine into a vertical bandsaw, or alternatively, by using the stand with a vice, the machine becomes a horizontal model, in which position it is semi-automatic in operation requiring no attention during cutting. Other extras include guide rollers for slitting, and extra blades. *Soag Machine Tools Limited, Juxon Street, London, SE11.*

McLEOD GAUGE

No Secondary Pump



A NEW method of operation of a McLeod gauge removes the need for a secondary vacuum pump.

This results in a very compact unit measuring 15 in high (without the legs) which is suitable for either bench mounting or for building into equipment. A vacuum-balanced piston is used to displace the mercury into the glass gauge head, the balancing vacuum being maintained on the piston via a second leg of the gauge head connected to a point above the top level the mercury can reach. Operation is controlled by a handle which is turned through approximately 90° to raise the mercury for measurement.

The glass gauge head is totally enclosed and adjustment of the scale is from outside. No special precautions are needed when evacuating the gauge prior to measurement. Two heads and scales are available covering from 10^{-4} mm to 1 mm of mercury, and from 10^{-3} mm to 10 mm. *NGN Electrical Limited, Accrington, Lancashire.*

Special Article

Use Information Departments for Selling

Inherent in the information reaching a company's intelligence department are business opportunities—if only they are recognised.

By Eric N. Simons

OVER the last few years the growth and development of information services has been of great importance to industry, and it is now recognised that the collection and dissemination of news about what is going on in the technical world are essential to industrialists, engineering specialists, designers, research officers, and so on. What is less commonly stressed—and indeed is rarely mentioned, even in some of the information services themselves—is the importance of the information service to the commercial and economic side of engineering.

Let me take a case in point. If a large cement-making plant is to be built in a particular country, it is not long before the local agent finds out, and notifies his principals, who at once make contact with the consulting engineers, in an endeavour to obtain business, assuming they are in principle agreeable to quoting for, and financing, the eventual contract. The contract may or may not be obtained. The loss of the contract may be attributed to a variety of causes; but it is suggested here that very often the true cause is failure to obtain the necessary information early enough.

FIRST ON THE SPOT

By the time the construction of such a plant has been decided upon in the particular territory, matters have gone too far for the British maker to be sure that he can obtain the order. He is merely one in the queue, so to speak, and must take his chance. But the essence of the matter is that the plant was there potentially long before the scheme was devised or the project discussed. Hidden in the structure of that territory were the limestone (or chalk), the water, the labour, the economic situation, the demand for houses and buildings, roads and docks, that would ultimately lead to a cement plant scheme. Why did not the British maker take the initiative and himself introduce the project? He would then have been the first in the field.

The answer, I suggest, is that he has no proper machinery, no habit of systematic inquiry, no specific orientation of his information services towards commercial and economic fields. His service will report to him a new machine for liquid extrusion of metals developed in the Soviet Union. It will not tell him of geological deposits in Siam and Timbuktu, of a clamour for houses in Tierra del Fuego, of land reclamation in the Dutch East Indies, and relate these seemingly random items to his particular marketing problems. In short, while he is aware of information as a valuable tool of production and technical development, he has no such awareness of it as a tool of market research.

If there is a well organised information service, it often happens that only the technical news is extracted. The fact that a particular town in Britain has started a trading estate, and has already sold land to a company which is about to make plastic products, is passed over. Yet if the products sold include such items as extrusion presses, cutting tools, etc., this news of a potential new customer is of value.

The primary need is for the management to give the information service a proper directive. Thus, makers of stainless steel, bridges, dredging equipment, structural steels, should insist on being told of new harbours, ports, dockyards, to be built, or where there is a likelihood that they would be of economic value to a particular territory.

Similarly, the information service itself should take the initiative and direct the attention of the management to grumbles and complaints in a particular territory. (Thus, the troubles of American motorists could have revealed much earlier the need for precisely such small automobiles as the British produce.) It should study the reports of municipal councils, whose discussions often reveal what is in the mind of its technical advisers, such as new roads, new schemes, new buildings, new equipment.

DRAW YOUR OWN CONCLUSIONS

The primary purpose of such services is to get the information *first*. By the time it has reached the stage of a detailed scheme, solemnly approved, with tenders invited, almost everyone will know about it. The prize these days goes to the man who can locate a need, discover that it can be satisfied, and initiate the satisfaction.

For example, the owner of a large estate in a British Dominion referred casually in conversation to the vast beds of oyster-shells that existed at a particular point of his land. It was pointed out to him that he had there a source of raw material for cement, and from this conversation sprang an order for a complete cement-making plant. Naturally, the contract went to the man who first pointed out the possibilities.

Let me take another example. It is known to most scientists that over considerable territories land is being successfully reclaimed from the sea by a process of planting a special kind of grass. Once this grass has established itself, it becomes possible to plant crops, feed cattle, and create a whole new agricultural district. Holland in particular has done this sort of work on a big scale. Yet until, many years ago, I pointed out the economic importance of these facts to a group of sales managers in London, no one had appreciated that this knowledge was valuable to agricultural engineers, makers of farm equipment and machinery, and all the other engineering materials that new communities require. This economic intelligence is precisely what an information service should discover and assess. Markets must be found, not merely awaited, and for this purpose information services are essential.

The kinds of economic material an information service should provide may be summarised as follows: (*a*) news of impending economic development of a particular country or area; (*b*) news of popular needs or complaints that may suggest openings for particular commodities; (*c*) assessment of economic conditions in particular areas; (*d*) reported statistics showing the proportion of use there of particular engineering items; (*e*) notes of contracts placed or tenders invited, in which must of necessity be embodied items made by the firm to which the information service belongs, thus enabling early approach to be made to the main contractor with a view to securing orders; (*f*) details of important changes in management or structure of particular customers or companies, which may have a bearing on relations with these customers or suppliers. For example, a failure over many years to obtain orders from one firm may be because the chairman has personal friendships with other makers. If he dies, retires or is replaced, it may then be possible to start negotiations afresh; (*g*) study and analysis of legislation in whatever area may be of interest, so that its effect upon manufacture and supply of products may be foreseen.

The above summary does not claim to be exhaustive. It merely outlines a few aspects of the commercial and economic work of the service. The question now arises: how is all this information to be obtained? Some sources are obvious and easy. A good press-cutting agency will feed into the service a wealth of cuttings on specific subjects. Much of this will have to be carefully sifted, and a proportion will be of little use. This does not matter. The Department of Overseas Trade provides annual reports on individual countries which contain much useful information, though it may be too generalised for immediate use; the trade and technical press contains many columns of brief notes which often go unread, yet may contain most valuable news. For example, it was a three-line paragraph in an engineering journal that first gave news of the discovery, by Mishima in Japan, of an aluminium-nickel alloy for permanent magnets. This news was conveyed to the chairman of a large company by its information service, and led directly to the introduction of this alloy into Britain. Only recently, this same information service has reported a Chinese magnet alloy to its principals.

Then there are Parliamentary debates on subjects of specific importance to the company concerned. Local journals give full accounts of municipal or rural matters that never reach the national press, yet often contain much advance information that can be commercially utilised. The various trade organisations produce official journals, copious notes, statistics, items of information, all worth examining. The reports of overseas agents, representatives and salesmen often contain incidental comments or news that ought not to be wasted.

ASIDES MAY MEAN BUSINESS

In this connection I well remember one salesman's report which read: "Called to see Mr. So-and-So, but he was busy at a meeting in connection with the big new plant they are going to build for . . ." Nobody paid any attention to this comment; but it was the rule in this particular company for all sales reports to go to the information service after normal routine treatment. The information officer immediately saw the implications. If X and Company were building a big new plant to make such-and-such, Mr. Y of the Plant Manufacturing Division ought to be told. Mr. Y had had no previous intimation, and the upshot was prompt action, and an eventual order for important new plant.

Trade union journals sometimes contain useful facts. So do house-organs and works magazines. In regard to the works magazine, a feature that can be interesting is the occasional account of a visit by members of the staff or workpeople to other factories or institutions. These sometimes indicate where an unsuspected market exists for a commodity the reader wishes to sell.

The great desideratum is obtaining the information early enough for it to be of service. Salesmen should be encouraged to send in notes on any development in their areas even before it has got to the stage of inquiries or tenders. It is much more useful for them to mention that a new shop for making mooring buoys is to be built in Inverkeithing, than to say, six months later, that they called at the new mooring buoy works there, and did or did not obtain an interview. In the meantime, steps might have been taken to establish contact with the men behind the project, and get a line on future business.

I do not propose to deal here with the mechanics of distributing the information when it has been obtained. This is a matter concerning which information officers require no instruction. What is more important is the question of *who* is to receive it. Directors of large companies are too often overloaded with paper, as it is. The presentation of yet more long, detailed reports is unlikely to be popular or to produce the desired result. What is needed is a weekly or monthly summary which cannot be matched for concision and significance.

In drawing up such a summary the information officer must know what will matter to his board of directors, and what will only be mportant to particular officials or individuals.

When Unfair Shares Mean Bigger Shares

In his concluding article, the author discusses the differing effects of a high bank rate on the economies of the United Kingdom and of Germany.

By Jossleyn Hennessy, M.A.

WHY IS it that, when circumstances compel a high bank rate, the economy marks time in the United Kingdom while expansion continues in Germany?

The differing attitudes towards production of organised labour in Britain and in Germany; the differing impacts on their economies of the "nationalised" industries in the United Kingdom, and of "State-owned" enterprises in Germany; and five United Kingdom economic handicaps and five German advantages were outlined in two previous articles (ENGNG., 17 Feb. '61, p. 249; and 3 Mar. '61, p. 322). Although important factors, however, these are not the whole answer.

The fundamental explanation of Germany's ability to secure an average rise in national income of 6·5 per cent a year between 1950 and 1959, compared with 2·7 per cent in the United Kingdom, is that she has reverted to the "production-orientated" type of economy which prevailed throughout 19th century Europe, whereas Britain is predominantly "consumption-orientated." These somewhat formidable terms of economic shorthand are easy to understand if the driving forces of Britain's economy in 1961 are compared with those of 1861.

DRIVE FOR PROFIT

In 1861, it was the entrepreneur's drive for profit that multiplied wealth. He saw the possibilities of new techniques. Free trade forced him constantly to search for new markets. Low rates of taxation allowed the big profits which enabled a small man to back his risk-taking vision and grow into a big firm. Today, high taxation keeps the small man small, and discriminates in favour of the large established firm. This change narrows the field for men with new ideas, favours established products, and impedes change and growth.

Firms making enough profits to meet replacement costs, and to pay their taxes and a modest dividend, are not *adding* to national wealth. What causes growth is the hope of exceptionally big profits. Without this incentive, who will put up the extra capital for costly experiments? This exceptional profit does not exploit the consumer, because, once a new idea has been proved a money-maker, competitors cash in on it, wages and other costs tend to rise, prices to be forced down, and old-fashioned firms to be taken over, or weeded out. The result is a bigger cake. In all this endeavour, the desire of the masses for greater welfare is not the initiating force, although greater welfare is achieved: between 1850 and 1904 *real* wages in the United Kingdom were doubled.

Of course, in 1861, most of the increased income went not to the workers but to the middle classes, that is, to those who (when taxation is not punitive) consume relatively little and save relatively much. The average 19th century middle-class man preferred the power which investment gave to the pleasures of consumption. It was, as Keynes pointed out, the *unequal* distribution of wealth which made possible those vast accumulations of fixed capital—new harbours, bridges, railways, industrial plants, cable systems, and so on—which distinguish the 19th from all previous centuries. Investment on that scale cannot occur when taxation redistributes surpluses. The railways of Europe and America were built by workers who did not immediately consume a "fair" share of the results of their labours. The saving-and-investing middle classes were allowed their "unfair" shares because, in practice, they consumed only a small part of them. "Saving became nine-tenths of virtue and the growth of the cake the object of true religion."

The cake was, however, small in relation to the potential consumption of the millions. If it had been shared "fairly," the poor could hardly have risen above subsistance level, first because, in relation to their millions there was little of it, so that fairly-shared slices would have been thin to transparency; and, secondly, because the mass consumption of these extra slices, however thin, would have simultaneously consumed what the middle classes would have invested.

What ended the golden age was, first, the splintering of the great economic units of pre-1914 Germany and Austria-Hungary into small, nationalistic units. Secondly, to the masses, the lesson of the First World War seemed that governments could afford limitless expenditure on destruction. Why could not equally massive expenditure raise living standards in peace? They did not see that, in war, capital had been recklessly consumed and that, before living standards could be raised, new accumulations were necessary. Nationalistic policies, pursuing the illusion of economic self-sufficiency helped to induce depression, which, in turn, intensified protectionism. Since economists had not yet found a solution to depression, unemployment further undermined the confidence of the masses and the entrepreneurs alike in free enterprise. Germany went over to a State-controlled economy.

After the Second World War, memory of the depression dominated British thinking. The United Kingdom became a welfare State. Welfarism spreads the idea that everyone is entitled to continuous employment, at rising wages, in the same job, in the same locality. The economy loses flexibility. Investment is increasingly cautious, non-speculative, induced. *Consumption dominates.* The economy tends to become static.

GERMAN VIEWPOINT

German economists point out that, in a consumption-orientated economy, it is not up to the worker to "better himself" but up to his trade union and the government to "raise living standards." Whereas, in a production-orientated economy, the individual's attitude is "Nobody owes me a living: I owe that to myself." In a welfare State, everyone, as Herr Erhard puts it, "lives with one hand in somebody else's pocket." The relation of cause and effect between personal effort and a higher income is blurred. Restrictive practices, shortening hours, and earlier retirement diminish output and raise costs. The government is forced to intervene more and more in the economy because (1) the price mechanism cannot effectively distribute resources when inflated demand is using up too much of the national product, and (2) saving is made difficult by progressive taxation and social security seems to make it less necessary. Ever increasing inroads are made on static resources by consumers, by companies trying to expand in response to artificially-swollen demand, and by the government seeking to increase social expenditure.

Walter Eucken, the economist, who laid the theoretical foundations of the German "miracle," shows in his book *This Unsuccessful Age* (W. Hodge, London, 1951) that not only did inflation destroy the price system, and hence freedom of individual choice, not only did it foster central planning, but inflation was itself a pre-condition to the inauguration of planning. Appreciation of this cause and effect is, Eucken asserts, one of the lessons of German experience. Politicians first claim that they have given the people full employment. After this has led to inflation and production bottlenecks, they next claim that by priorities, licences, and permits, they are enforcing fair shares and the scientific distribution of the goods and services in the short supply which they have created.

In times of suppressed inflation, induced by pegged prices, firms and households have considerable cash holdings. Firms can therefore comply with restrictions on the use of stocks, with production directives, and prohibitions of the sale of goods. They can afford higher wages and new allocations of raw materials precisely because their cash holdings are swollen. But, when firms and individuals have to work hard to earn money in a competitive market, that is, as economists say, when money becomes scarce (as it did after Erhard's currency reform of 1948), they have to sell stocks of finished goods in order to keep going and avoid closing down. Firms whose products fail to attract customers can no longer pay their way.

It is sometimes argued that Germany's rapid post-war expansion is a statistical illusion because, of course, if you start from scratch, you can show a faster rate of development than if you start higher up the scale. True, but the point can be discerned when recovery merges into advance. Their index of industrial production, with 1936 as 100, had risen to 111 by 1950, to 154 by 1953, and to 309 by November, 1960; that is, to more than three times the pre-war level. In comparison, the United Kingdom index is today only 75 per cent above its 1938 level. By 1957, Germany had more than doubled her national income of 1936 and, despite her increased population, income per head was 50 per cent above pre-war.

POST-WAR CONTRASTS

The difference between the German and British post-war achievements has arisen because the United Kingdom upheld (at any rate until recently) the "fair" shares ideal of reduction of inequality by heavy taxes; Germany granted tax exemptions to anyone ready to work, save, invest, and produce. Of course, Germany's millions of refugees provided cheap labour, but, if they had insisted on "fair" shares, the average industrial wage would not be £10 15*s* a week, and Germany would be an underdeveloped country with starving masses on the Asian scale. The average German weekly industrial wage is £3 5*s* less than the British. Between 1950 and 1960 money wages in Britain rose 80 per cent, but, allowing for inflation, *real* wages rose by a mere 20 per cent. Between 1950 and 1960, real wages in Germany rose by 67 per cent. It looks, therefore, as though the German worker is better off with his £10 15*s* a week than the British worker with his £14.

Germany's membership of the European Economic Community, with its market of 162,000,000 persons, is a further step towards re-establishing the pre-1914 conditions, in which the European entrepreneur was supreme amidst a minimum of international barriers to trade. Indeed, as the phases of the EEC plan are completed, conditions will be better than pre-1914 because there will be no internal barriers whatsoever to trade, and in addition, there will be international institutions, which did not exist before the First World War, to coordinate individual national economic policies.

Although the labour shortage, added to party electioneering rivalry, is boosting welfare ideas in Germany, hateful memories of Hitler's controlled economy, together with the prestige that the "miracle" has given to free enterprise, seem likely to give entrepreneurs elbow room for an indefinite period. Since the war, 3,502 Germans have become D Mark millionaires. They are not viewed with envy and disapproval.

Universal Provider

THROUGHOUT 1961 the International Atomic Energy Agency will send 31 nuclear experts to Argentina, Brazil, Ceylon, Greece, Iceland, Indonesia, Israel, Korea, Mexico, Morocco, Pakistan, Philippines, Sudan, Thailand, Turkey and Yugoslavia. Thirteen of these sixteen—countries will also receive nuclear equipment to a total value of $191,200 which will be required to support their national atomic energy projects and to assist in the work of the Agency's experts. In addition, the agency will assist 35 countries under the United Nations Expanded Programme of Technical Assistance. An outline of the various projects is given below. It is rapidly appreciated how much the smaller country with poor financial sources is benefiting from the influence of the IAEA. The advantages of atomic energy used for peaceful purposes have now been extended on a much wider front. The basic difference between the IAEA and Euratom is that the former is trying to establish something which in most cases is not yet existing, but the latter is, in most cases, expanding an established industry on a much narrower front.

Argentina

The National Atomic Energy Commission is developing uranium deposits and processing uranium ores to produce uranium metal for use in its nuclear facilities (Atomic Review, 27 Jan. '60). The Commission intends to develop uranium metal production on an industrial scale having already built some facilities for this purpose, and an IAEA expert will be sent to assist the local authorities in carrying out the preliminary investigations up to the stage of plant and process design. A programme for the separation of stable and radioactive isotopes for nuclear physics research is proceeding and an expert in the separation of enriched isotopes and in the electromagnetic separation of radioisotopes obtained with beta and gamma sources will be arriving shortly. Some nuclear equipment will also be provided. Another expert will be arriving to study farm animal nutrition and breeding, using radioisotopes and tracer techniques. This could be of profound importance to Argentina who relies heavily on the exporting of livestock to support her budget.

Two visiting professors under the IAEA's exchange programme will help to carry out work in solid physics at the Bariloche Physics Institute for which $27,000 (£9,650) has been allocated to supplement the basic laboratory equipment.

Brazil

A grant of £8,200 and the services of two experts is to be made to the Radioisotope Laboratory of the National Cancer Institute in Rio de Janeiro. One will be an authority in the clinical uses of radioisotopes, and the other in radiochemistry, with particular reference to the metabolism of internal contaminants. Further support and advice will be given to the School of Agriculture at the University of São Paulo in utilising radioisotopes in agricultural research.

Ceylon

A geologist and an electronics technician sent by the Agency will assist the Sinhalese Government in a geological survey for radioactive minerals over the whole of Ceylon. This is part of the programme to explore the country's mineral wealth.

Greece

A neutron physics expert will be sent to assist in a research programme in neutron physics at the Greek Nuclear Research Centre. Another expert will advise in the use of clinical radioisotopes and assist in research work.

Iceland

An expert and £3,790 worth of nuclear equipment are being sent to the hospital of the University of Iceland, in order to establish routine diagnostic and therapeutic services with radioisotopes.

Indonesia

Three IAEA specialists are to be sent to Indonesia. The first will work in the Chemistry Department of the Institute of Technology at Bandung and will be connected with the low power research reactor to be built by the end of 1961. (Atomic Review, 2 Sept. '60.) The second, an authority in radiobiology, will advise the Radiation Laboratory of the proposed Atomic Energy Institute at Djakarta on possible programmes that the Institute could profitably undertake. The third will assist the geological survey in Bandung to gain experience in carrying out analyses of radioactive ores by various methods.

Israel

An IAEA expert in the design of nuclear reactors will assist the department of Nuclear Science at the Technicon-Israel Institute of Technology in the preparation of training courses and demonstrating the design of nuclear reactors. A further £8,950 is also being provided for monitoring equipment to be installed around the reactor near the towns of Rehovat, Ness-Ziona and Rishon (Atomic Review, 3 Feb. '61).

Korea

The Institute of Agriculture at Suwon is to receive assistance in the agricultural applications of radioisotopes. Also, an expert in health physics will help in establishing adequate radiation protection services at the Atomic Energy Research Institute being constructed near Seoul, where a 600 kW pool-type Triga Mark II reactor is to be installed.

Mexico

Five IAEA members are to be sent to Mexico to develop the research programme on the use of radioisotopes in agriculture; to investigate and explore the radioactive ores and beryllium ore deposits and to provide a suitable development programme for their extraction; to design and make nuclear electronic equipment and to advise and coordinate the present activities concerned with the production and repair of nuclear equipment; to advise the National Commission of Nuclear Energy on the problems of radiation dosimetry; and to aid the Commission's planning for a uranium ore processing plant which is now under consideration.

Morocco

Radioisotope application to agriculture will be introduced and an expert will train personnel and formulate a research programme. £1,200 is being provided for equipment.

Pakistan

The Pakistan Atomic Energy Agency plans to establish two agricultural radioisotope research centres, one in the West and the other in East Pakistan. The Agency will provide a member to advise in this field and it is also contributing £4,300 towards nuclear equipment.

Philippines

Two experts and £7,830 are being allocated, one expert will assist in the organisation and establishment of the film badge service and dosimetry unit at the nuclear research centre now under construction. The second member will advise the Radioactive Laboratory of the Philippine General Hospital in carrying out a project for the investigation of the processes involved in the formation of thyroid hormones using radioisotopes.

Sudan

A raw materials analyst will visit Sudan to assist local organisations in determining the amount of uranium in the copper ore body discovered in the province of Darpur. The analyst will also officiate in the installation of the necessary equipment and training personnel.

Thailand

Nuclear equipment valued at £3,570 is to be supplied to facilitate the work of an Agency member who has been prospecting for nuclear materials since 1960.

Turkey

The Turkish Government are to receive an Agency grant for equipment to initiate a training course in radiochemistry and to begin research in this field. Another grant will also be made to assist the Faculty of Science of the University of Ankara in establishing a nuclear physics training and research laboratory and in preparing research programmes. The Agency are sending an expert and a grant of £3,920.

Yugoslavia

An IAEA member experienced in the toxicology of radioactive materials will advise the staff of the radiological laboratory at the Institute of Medical Research in Zagreb on various problems connected with the metabolism of fissionable products and radiotoxicology.

Assistance Missions

The Board of Governors has approved the sending of a preliminary assistance mission to Ghana, who became a member state in September, 1960. Visits by the mission to Dahomey, Liberia and Nigeria have also been agreed. These countries are not yet members of the Agency. The mission will gather information on the nuclear energy programmes and will assist the Governments concerned to assess their requirements and the extent to which these might be met by Agency aid. The members of the mission may also visit the Cameroons.

Trilateral Research Agreement

Research on the effects of radioactivity in the sea is to be undertaken after completing a recent agreement between the IAEA, the Government of Monaco and the Oceanographic Institute of Monaco. The research will be conducted at the Scientific Centre of the Monaco Government and is related to the problem of possible pollution of the sea through the deposition of radioactive materials. It will investigate the movement of water and marine organisms and the deposition of organic and inorganic matter; the distribution in marine organisms of radioactive materials already existing or that may be introduced into various locations; and the effects on marine life of radioactive materials at various concentration levels.

Seventy Contracts for Euratom

Euratom has signed seventy contracts representing a total commitment of £9·64 million. The contracts vary from investigations on controlled thermonuclear reactions to mineralogy at the South Pole. They have been placed as follows: 20 in Belgium, 9 in West Germany, 19 in France, 4 in the Netherlands and 1 in Switzerland (the latter is not a member of the community).

Too Much for Euratom Joint Research Centre

The research programme of Euratom is carried out in the branch establishments of the Joint Research Centre and various organisations and firms in the member states. The setting up of the Joint Research Centre is nearly complete. It consists of three branch establishments: the Ispra centre, the Central Nuclear Measurements Bureau, which is already in operation; and the Karlsruhe Transuranium Institute, still under construction. The Commission is now negotiating with the Netherlands to set up a further establishment at Petten. Since the Joint Centre cannot carry out the entire Euratom research programme itself, awarding of the 70 contracts to various bodies and enterprises in the member

countries is an obvious step. This contract system will also give an added impetus to nuclear research in Europe.

Allocation of Contracts

Thirty-one of the contracts have been signed under the United States Euratom agreement (Atomic Review, 18 Nov. '60) and all are connected with the boiling—water reactor system with special reference to the Italian Garigliano plant. Twelve contracts have been signed under the Orgal Project, which is designed for the study of the natural uranium, heavy water moderated, organic liquid cooled reactor system. The Project provides for the construction of a specific test reactor, Essor. Ten contracts have been signed in connection with research carried out by a data processing team, where an examination is being made of the extent that it is possible to use automatic processes for abstracting and translating scientific texts. Seven contracts of association have been made. These usually consist of offering assistance to projects that already exist, the size of the financial and technical resources required being too much for the individual country. The remaining contracts relate to measurement work, mineralogy, and a fast reactor study.

Notes and News

Berkeley Nuclear Laboratory

The opening of the nuclear laboratories at the Central Electricity Generating Board's Berkeley Station will take place on May 29 (Atomic Review 24 Feb. '60). It will be followed by a four-day international conference on the "Properties of Reactor Materials and the Effects of Radiation Damage," to be held in the Great Hall of Berkeley Castle.

The laboratory, a view of the model is shown in Fig. 2, will give the CEGB an opportunity to carry out work that the Atomic Energy Authority is not in a position to conduct, since the latter has not the same facilities, and it will also provide independence instead of becoming a puppet to a large organisation. At this stage it is not proposed to examine the feasibility of other systems: this will be left to the Authority who are undoubtedly the better suited for the purpose. All the information the CEGB derives will be available to the Authority and the consortia.

The laboratory has a series of caves and cells for operations on irradiated fuel elements. There is still much to be learnt about the failure of fuel elements and the causes of failure. It is hoped that the work will lead towards the improvement of fuel element design. The graphite moderator will be monitored throughout the life of each of the civil power stations. Measurements will be made of stored energy, and dimensional and strength changes in many graphite specimens installed at various points in each reactor core. A detailed study of the gas-graphite reaction is to be made under dynamic conditions, since this reaction may be a vital parameter governing the reactor life. An instrument section will work primarily on nuclear radiation detectors and "in-pile" measuring techniques.

Reports Received

Neutron Density Measurement: A method for the measurement of neutron density making a beta ray autoradiograph of a thin detector irradiated in the neutron flux to be examined is given. Descriptions of the preparation and standardisation of the detectors, and the choice and standardisation of the emulsion are explained. The method is well suited for the study of neutron behaviour in the neighbourhood of strong absorbers. ("Neutron Density Measurements by Autoradiography of Detector Foils," by A. Ertaud and P. Zaleski, AEEW—Trans. 1.)

Bibliography on Radioactivation Analysis: A supplement to AERE I/R 2208 has been published, and covers all literature from June, 1957, to July, 1960. The index is in three parts, covering reviews and general articles, elements determined, and matrices. ("Radioactivation Analysis—A Bibliography First Supplement," by D. Gibbons *et al*, AERE I/R 2208, Supp. 1.)

Ultra-Violet Radiation: The most promising method of producing vacuum ultra-violet radiation of high intensity appears to be an inert gas resonance. Only massive windows of lithium fluoride proved sufficiently robust to be used for the window material possessing high transmission of radiation, and these set a limit to the lamp at

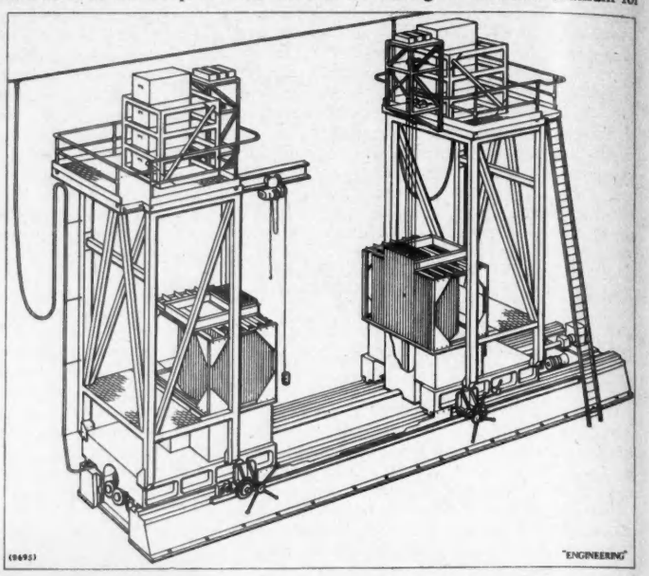


Fig. 1 (right) Artist's sketch of VERA (Atomic Review, 10 March '61) showing the split core, designed to give safe loading.

Fig. 2 (below) Model of the CEGB's Berkeley Nuclear Laboratories.

1,065Å. ("Vacuum Ultra-Violet Source Radiation of High Intensity" Part 1, by F. S. Feates *et al*, AERE—R 3462.)

Pulse Amplitude Analysers: Pulse generators using mercury-contact relays have been developed to provide an accurately known and stable output demanded by pulse height analysers. The report describes the philosophy of design and theory behind the operation and indicates various improvements. ("Precision Relay Pulse Generator for Use with Pulse Amplitude Analysers," by M. O. Deighton, AERE—EL/R 2717.)

Generators for Neutron Choppers: Two electromagnetic signal generators are described and performance given. One type generates a continuous sine wave whose amplitude is approximately proportional to the rotor speed, and the other generates pulses suitable for triggering a timing unit. ("Electro-Magnetic Speed Signal and Pulse Generators for Neutron Chopper Spinning Units," by L. V. Lewis, AERE—M 626.)

Integrating Flame Photometer: The design of a flame photometer is described with either direct reading or integration facilities. Automatic background correction assists the sensitivity and stability of the instrument. An internal standard channel may also be provided. ("General Purpose Integrating Flame Photometer," by H. M. Davis, AERE C/R 2659.)

Reactor Notes

University News: The USAEC will issue a licence for the operation of a 100 kW(t) water cooled and moderated teaching reactor at Washington State University.

US Shipment for France: The United States has made a shipment of 20 kg of enriched uranium to France for use in the development of a land base prototype submarine nuclear propulsion plant. An agreement made in 1959 allows for the transfer of 440 kg of enriched uranium for use in this project, and further shipments will be made when the material is required.

Kiwi Progression: The successful completion of the Kiwi-A3 reactor using high pressure hydrogen gas for its propellent has spurred the United States Atomic Energy Commission and the National Aeronautics and Space Administration to invite further proposals for the research and development of a nuclear rocket engine. This will include assistance in the Kiwi-B test programme, a preliminary design study of the flight engine, and the formulation of an engine development programme.

Withdrawal from Cooperative Arrangement: Due to the withdrawal of the cities of Los Angeles and Pasadena from participation in the 50 MW(e) Improved Cycle Boiling Water Project, the USAEC is now considering other alternatives. The cities have withdrawn because it is felt that the size is inadequate for the area, and also because the estimated cost of power from the proposed plant was going to be higher than the original estimate.

Further News about SL-1: Severe damage to the core has been revealed by films taken from the cameras looking through five 24 in long and 6 in diameter nozzles penetrating the head of the reactor (Atomic Review, 10 March, '61). Taken remotely from the end of a crane boom, the films showed bending and expansion of the core and disclosed the presence of bubbles, giving evidence that there is water in the core. Four of the five control rod blades appear to be partially or fully in the core and one entirely out of the core.

Arrival of ML-1: The ML-1 (Mobile Low Power Prototype) reactor designed and constructed for the USAEC by Aerojet-General has arrived at the National Reactor Testing Station, Idaho. The ML-1 is skid mounted and transportable by truck-trailer, aircraft, train or barge. It can be placed in operation 12 hours after arrival or be ready for movement 24 hours after reactor shutdown. It produces 300 kW(e) and uses a direct cycle, gas-cooled system.

Latest Submarine: The newest United States nuclear submarine, Sam Houston, was launched last month at Newport; it is the second in the Etham Allen class, both of which are powered by Westinghouse reactors.

Companies

English Electric and the Future

THE future of the British economy depends in the long term on expansion of its overseas trade in capital goods. These are not simply sentiments from Lord Nelson, the ENGLISH ELECTRIC Company's chairman. Almost a third of the group's immense total business is exported.

Many overseas countries are moving away from dependence on primary products. They are manufacturing locally more and more of the products formerly bought from Britain and other industrially quicker - off - the - mark nations. But they are in the race now, and certain once traditional fields for export are being cultivated by the local workers.

Lord Nelson declares, in his annual English Electric statement, his welcome for these changes—due to the increasing opportunity they bring for the export from Britain of the capital goods needed in the establishment of manufacturing industry.

One result of the company's view here has been the setting up of factories in Canada, Australia, India and South Africa and the creation of selling organisations able to cope with the importation of British built capital equipment.

After a year, 1960, in which production was almost exactly the same as 1959, there are now substantially higher levels of orders than ever before in the company's history. On this basis there is the reasonable expectation that 1961 will be a year of increased output.

The overall accounts for English Electric and its subsidiaries shows a fall in the trading profit and in the profit after tax and depreciation.

The parent company and certain subsidiaries had substantially better results than in 1959. The overall drop in profitability was caused by losses in the Italian Marconi subsidiary, MARCONI ITALIANA, in the engine firm D. NAPIER, and in the Canadian interests.

The annual statement includes a valuable breakdown of the sales turnover, as below.

Where the Money Went

	£
Raw materials, bought out and semi-finished articles embodied in company products	48·15
Wages and salaries	33·93
Depreciation, maintenance, power, heat, light, rent, rates, insurance, etc.	12·22
Interest on debentures, bank overdraft and bills	1·70
	96·00
	£
Paid in taxation	1·73
Retained in business	1·09
Paid in net dividends on Preference and Ordinary Stocks	1·18
	4·00
	£100·00

The MARCONI WIRELESS TELEGRAPH Company maintained its level of turnover but with a lower trading profit. The company now has a greater level of orders. MARCONI INSTRUMENTS Limited enjoyed a very successful year stepping up the intake of orders, the turnover and the profit. Since the acquisition of Marconi Italiana SpA it has been found that inadequate provision had been made for losses by the company before 1960. The book value of the investment, plus the development expenditure of the year, totalling £670,000, have been written off.

With a long list of important technical advances to its credits, the company spent a busy year equipping television and broadcasting stations. In the course of the year stations were completed in the United Kingdom, Australia, Brazil and Nigeria. Definite orders came in from New Zealand, Canada, Venezuela, Mexico, the BBC and from ITA.

MARCONI INTERNATIONAL MARINE COMMUNICATION enjoyed some of the benefit of what improvement there was in shipping during the year. An unusually large proportion of business placed with the company has been for radio equipment for new British tonnage and there have also been satisfactory results in the export markets.

Development outlay and early production costs of components of the D. Napier company have been written off. Further Government contracts are expected for the Gazelle helicopter engine in service with the Royal Navy and the Royal Air Force. The company also sees a future for this engine in internal civil helicopter applications.

In Canada, the JOHN INGLIS Company, despite the slow expansion of the economy, was active in water turbine manufacture, paper making machinery, domestic appliances and other fields. The first steam turbo-alternator set, a 100 MW unit and the first to be made in Canada, was produced by John Inglis. The English Electric Canada division of the company has constructed the largest transformer in Canada, a 400- MVA unit; it controls the flow of surplus power regularly exchanged between Ontario Hydro and the Niagara Mohawk Power Corporation.

English Electric	1960 £	1959 £
Balance on Trading Account	10,839,706	11,445,372
Profit after tax, depreciation and other provisions	3,792,066	4,159,259

Sperry Establish European Company

Rising commitments with Government and private customers in Europe have led the SPERRY GYROSCOPE Company, a division of the SPERRY RAND Corporation, of New York, USA, and also of Brentford, Middlesex, to form the SPERRY EUROPE CONTINENTAL Company for sales and service in Western Europe.

The new concern, with its headquarters in Paris, will represent Sperry in patent, licence and contract negotiations. President and director general of the company will be M. Rene Laureau, formerly the chief of his own firm, Société d'Equipments Aeronautiques Laureau & Cie.

Immediate responsibilities of Sperry Europe Continental will include the general line of aeronautical products and systems of the Sperry New York, London and Montreal companies. Among these are flight instruments, automatic pilots, navigation equipment and radars employed in business aircraft, large transports and military planes.

Better Jaguars But Bigger Costs

The standing of Jaguar cars among sports models and high performance saloons produces a series of interesting against-the-trend results.

While the United States is in recession and, by the introduction of compact cars, has sharply reduced the imports of European cars, particularly those from Britain, the JAGUAR CARS Company increases the volume of its sales through the New York subsidiary, JAGUAR CARS Incorporated.

Shipments to Canada also rise in amount and there is a 20 per cent improvement in sales to Common Market countries. Since sales in the European Economic Community had increased 10 per cent in the previous year there has now been an increase of almost a third in Jaguar sales among the Six since the announcement of the Common Market agreement. Despite this growth, Sir William Lyons, the Jaguar chairman, hopes that the integration of the Common Market and the British-led Outer Seven will not be long delayed. Sales to the European Free Trade Association did better last year and the future prospects are believed at Jaguars to be extremely promising.

After the rising turnover of the year and the introduction of the well received Mk II Jaguar there was some surprise when the trading profit was discovered to be £500,000 down on the year before.

Sir William Lyons gives three reasons for the changed position of the profit and loss account. Delay in bringing out the new model caused the year to open slowly but vigorous efforts were made to catch up with the demand and as the financial year closed the company was in a position to feel that the optimistic hopes for the Mk II had been justified.

The second cause given by the chairman was that in consequence of the high rate of profit in the previous year, profit margins were reduced in keeping with company policy to give "even greater value" in the cars. Sir William Lyons and Mr. W. M. Heynes, director and chief engineer (inset), carried through marked advances in the specification for the Mk II.

Rising costs are given as the third reason for the decline in profit margins. On this point Sir William declares that if there is continued efficiency, the only way to increase profit margins is by stepping up production. He is surprised that the motor car industry's programme for greater volume in output should be regarded by some people as unwise. The industry cannot be competitive unless its costs compare favourably with its competitors. If increasing costs have to be absorbed the only way this competitiveness is going to be achieved, or retained, is by increasing output. Selling more cars will certainly, in Sir William's view, be no more difficult than selling a smaller number of higher priced models.

On the acquisition of the Daimler company, Jaguar now expect that the utilisation of the more than a million square feet of space the purchase brought them, and the establishment of a satisfactory basis of production for the Daimler cars and transport vehicles will take "quite a considerable time" before it is completely effective.

Substantial production is being started this spring of the Daimler rear-engined Fleetline passenger vehicle, first shown at the Commercial Vehicle Show at Earls Court.

Jaguar Cars	1960	1959
Trading Profit	£2,289,457	£2,833,412
Profit after Depreciation and Taxation	£1,039,289	£1,383,428

Disappointing Half-Year in Safety Glass

The decline in the British motor industry's activities brought a sharp fall in the general level of activity of the TRIPLEX group.

The company's half yearly report states that the unaudited, before tax profits, fell from £869,969 in the half year July to December, 1959, to £347,958 from the comparable period of 1960.

Confidence in the future is shown by the continuance with the planned expansion programme, in accordance with the decision of the Triplex board "to provide capacity for all the motor-car industry's future need for safety glass." The prospects for the next few months are not as good as the more distant future.

Triplex believe that even given a marked upswing in demand for safety glass in the next few months it is unlikely that demand will exceed existing installed capacity for some time.

The engineering factories of the Triplex group are all well occupied. Their profits are described as "appreciably in advance" of the corresponding period six months ago.

Decca Navigator Mark 10

The recent Brooklyn air disaster spotlighted the need for more accurate navigational aids to assist in aircraft separation around increasingly busy airports.

THE Decca Navigator provides the airline pilot with an important extra navigational facility, namely, a pictorial record of the track flown. It thus recognises the significance of the changing navigational needs of aircraft as speeds increase and as congestion grows around busy airfields.

The first application of the Decca principle was to marine navigation, and ship installations still account for the majority of the 7,000 receiver sets now in use. The Mark 10 is a recent development of the Decca Navigator intended specifically for aircraft application; although one of the beauties of the basic Decca system is that once a chain of ground transmitting stations has been set up, the signals they produce can be picked up equally well by either surface or airborne craft.

In the early days of aeronautics, the pilot generally flew low enough to be able to distinguish landmarks on the ground. He was thus able to find his way about by means of a map and by following roads, railways or rivers.

The first use of short range wireless telegraphy was to provide homing beacon bearing data from ground direction-finding stations. This was followed by direction-finding equipment being installed in aircraft to obtain bearings from ground beacons. Both of these applications meant having a Radio Officer in the aircraft, and on longer flights a Navigator also.

Another system worth mentioning, and which was used extensively during the Second World War for navigating one-man fighter aircraft, is that of ground plotting. Here a staff of ground personnel fixed the aircraft's position from signals received from its own transmitter by a pair of ground stations, and then radioed position and course back to the pilot.

A homing beacon is a " point source " system, in other words, the signals emanate from a point, and positional accuracy, excluding aircraft instrument errors, is directly proportional to the distance from the source. Despite this limitation, many other point source systems were developed as time went on and some are still in use. The most important is the VOR system, which is recognised by ICAO (the International Civil Aviation Organisation) as an agreed standard short range navigational aid.

During the last 20 years, in an attempt to overcome the inherent limitations of a point source, " area coverage " systems have been introduced, in which signals are transmitted from a chain of ground stations and positional determination is obtained by correlating the signals from a number of stations. The two most important were the GEE system developed during the early part of the Second World War and which later failed to gain ICAO recognition; and the more recent Decca Navigator which, although not adopted by ICAO as a standard basic aid like VOR, is nevertheless encouraged.

Basically, the Decca Navigator system consists of three elements: the " chain " of four land-based transmitting stations; the receiver and display equipment on the aircraft (or ship); and the specially overprinted charts produced to individual customer requirements. Nearly twenty Decca chains are now in operation in the world, four of them being in Britain. British European Airways, for example, have installed the Decca Navigator equipment in most of their current fleet, additional to that associated with the ICAO standard aids.

The Decca Navigator owes its conception to an American, W. J. O'Brien, about 1938. O'Brien tried for years to obtain some support for his invention in his own country, but without success. In 1939 he turned to Britain and got in touch with Mr. H. F. Schwarz, chief engineer of the Decca Record Company. He and Decca's chairman, Mr. E. R. Lewis, (now Sir Edward), both saw the possibilities of the scheme, which resulted in Schwarz returning to the USA with O'Brien to pursue further investigations into it. Between them they started a pilot system working satisfactorily in New Jersey, but still no interest was shown on that side of the Atlantic.

Schwarz then came home and succeeded in winning a contract for his company from the Admiralty for the establishment in England of the first Decca chain, consisting of three stations, one master and two slaves. It was used in the Normandy invasion of 1944, an experience from which the Decca system emerged with credit. The Ministry of Transport became interested, and when the first of the present English chains was opened, with three slave stations instead of two, the system was officially approved for marine navigation. By now the Decca Navigator Company, Limited, London, SE1, had been formed as a subsidiary of Decca Record, with Lewis as chairman and both Schwarz and O'Brien on the board of directors. It was realised that the logical step of applying the Decca system to aircraft should be pursued without delay.

FLIGHT LOG

By 1952 three chains in Britain and one in Germany had been commissioned. Airborne application at first entailed slightly modifying the receiving equipment and introducing the " Flight Log." This instrument automatically plots the track of the aircraft on a continuous strip chart, so that the pilot can tell his position at a glance as long as he is within receiving range of a Decca chain. The important extra facility of a continuous track record is not offered by any other contemporary system and it has undoubtedly played a great part in the success of the Decca Navigator in the air. Then in 1958 came the Mark 10 Decca in which a number of refinements were incorporated, not only in the receiving set but also in the nature of the transmitted signals.

Unlike previous subjects treated in Product Profile, the Mark 10 Decca is not merely a set of equipment that can be purchased, but is associated with Decca's provision of a navigational facility. The company build, and equip the ground stations, and operating arrangements depend on the country in which the chain is situated. The receiving equipment is usually manufactured by Decca, remaining their property, and is hired out to users of the facility on an annual basis. The flight log charts are produced to hirers' requirements at cover-cost charge, and a 24-hour service is provided.

The Decca system is a short/medium range low frequency hyperbolic area coverage system, depending on phase comparison between signals received from the four synchronised transmitters in the chain. The transmitters produce a navigational lattice of hyperbolic position lines or " lanes " between each pair of stations, as shown in Fig. 1. These hyperbolae are obtained by plotting the interphase points of such transmissions. The Decca system gives a continuous fix. It is also unaffected by line-of-sight considerations, a significant limitation with VHF systems, and transmissions can therefore be received right down to ground level.

The stations in each Decca chain comprise a master disposed more or less centrally between the three equally-spaced slaves, known as Red, Green, and Purple for plotting purposes. The slaves are situated roughly 70 statute miles from the master. Rated coverage is anywhere within

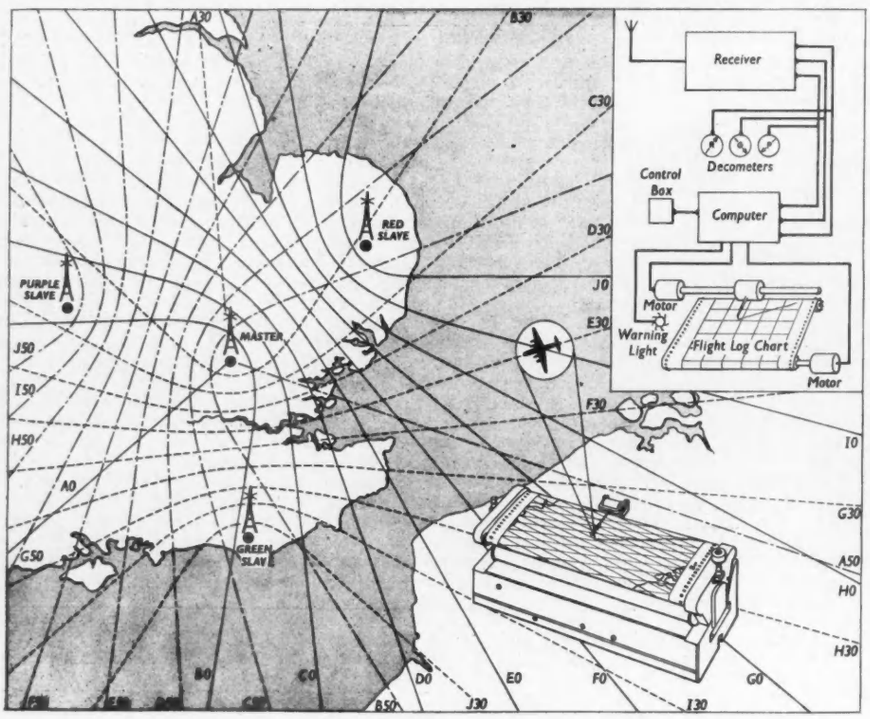


Fig. 1 Hyperbolic position lines.

Fig. 2 An instrument aimed at making life easier for the operator.

Fig. 3 A typical ground station.

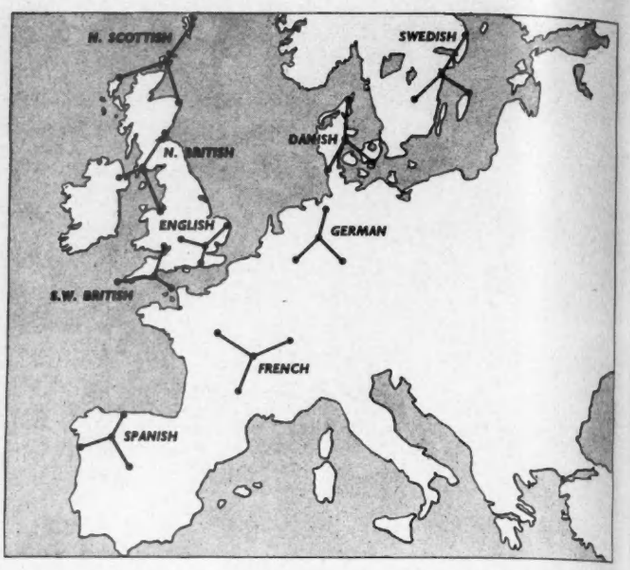


Fig. 4 (right) Decca coverage in Western Europe.

a radius of 250 miles from the master, and is the normal minimum range under the worst conditions. Actually usable signals can often be picked up at nearly double this distance.

Reliability is paramount in the provision of a service of this kind, and so all equipment at the transmitting stations is triplicated against failure. Power for transmission purposes is either taken from the Grid or from a diesel generating set. The standby generating equipment automatically "cuts in" if failure of the primary power supply occurs. Each ground station requires an aerial mast and some form of standby aerial array, and thus becomes quite a sizeable installation as Fig. 3 shows.

RECEIVING EQUIPMENT

The basic airborne receiving equipment consisted of a receiver, control box, flight log and three indicator dials known as "decometers." Signals from the four ground stations are received in crystal-controlled channels and the three slave signals are phase-compared with the master signal. The resulting signals drive the decometers which are designated Red, Green, and Purple, after the slave stations, and they count the number of lanes traversed. Thus the aircraft's position at any instant can be fixed by reading the decometers in conjunction with a chart on which the lanes are overprinted in the appropriate colours—and additionally the flight log traces the track covered.

The Mark 10 incorporated several improvements to appeal to airlines, aimed at simpler operation to put less onus on the pilot, elimination of lane ambiguity, and more positive "zone" identification.

Simpler operation was obtained by providing a computer connected in parallel with the receiver output, which automatically selects the optimum hyperbolic pattern and is linked to the scale of the flight log. Notching and other adjustments previously necessary to operate the receivers were eliminated and the only operation required with the Mark 10 is setting the meters in accordance with the zone identification display. Mark 10 receivers can be tuned in to any Decca chain by changeover switch.

Lane ambiguity has been eliminated by superimposing a "pulse" transmission on the normal continuous wave. Thus the basic hyperbolic patterns are generated in such a way that accuracy and reliability are retained even under conditions of severe skywave interference which would previously have introduced serious errors. The pulse transmissions take place three times per minute for each colour, but are short enough to allow the unimpaired use of the chain by other types of Decca receiver. Geometrically, the lane identification patterns are unaltered. The Mark 10 decometers, and corresponding elements of the flight log servo system, make one revolution for every 24, 18 and 30 Red, Green and Purple lanes respectively.

The zone (recurring group of hyperbolic lanes) identification facility shows the user three times per minute whether or not the decometer zone readings are correct. This identification is derived from a signal of frequency 8·2f from each station transmitted with the four harmonic signals, and eliminates for all practical purposes the ambiguities in the system.

Improvements to the Decca system such as the introduction of the Mark 10 have to be brought into operation sequentially to a carefully planned programme. It is not simply a matter of supplying new receiving equipment. With the Mark 10 the additional pulse and zone identification signals necessitated extension of the ground station equipment. Furthermore, it was soon found that the pulse signal was creating interference on the existing Decca receivers working on the continuous wave only, and each set had to be recalled and fitted with a suppressor.

The characteristics of Decca are such that its future is assured and its extension will continue as more countries and airlines appreciate its advantages over other systems. Apart from the convenience of continuous positional indication, the Decca system possesses an exceptionally high degree of accuracy which can reach within 2 to 3 yards under ideal conditions. In the air the operational accuracy can be of the order of 100 yards but it decreases at the extremity of cover and at night. It also provides excellent malfunction indication.

CHARTING SERVICE

Due to the hyperbolic form of the lanes, the chart distortion is naturally greater than would be the case if a straight line system could be employed. However, Decca's provision of a good charting service reduces the inconvenience to the user from this cause only to a minimum. Introduction of a new "Omnitrack" digital computer will eliminate this residual distortion.

Attention has also been paid to the convenience of chart loading to facilitate rapid changing. It will be appreciated that on a flight from, say, London to Paris three charts will be required, involving two changes in the air, since charts for the routes in the vicinity of the terminal points are necessarily to a larger scale than for the main part of the journey. With the Mark 10 receiver the chart changing operation is partly automatic.

It is only a matter of time before the Decca system becomes a basic ICAO requirement due to its inherent accuracy coupled with the use of a pictorial display. These two features render it eminently suitable for conditions of high traffic density such as exist in terminal areas. VOR cannot compete on these terms and demands the installation of highly elaborate ground radar systems to deal with air traffic control.

In addition to the fixed ground stations Decca also run a survey service using mobile stations for land or hydrographical exploration. Derivatives of the basic Decca system are also reflected in alternative receiving equipment for specific purposes, for example, in military aircraft, and the system has particularly proved useful to the fishing industry and for undersea cable laying. A long range system is also being developed known as "Dectra" to provide high accuracy coverage over long distances. Dectra has already begun operational trials across the Atlantic.

The form of Decca presentation lends itself to possible future autopilot applications. Perhaps one day an airliner will be able to fly from London to New York under automatic navigational control all the way.

Fig. 5 The decometers are designated after the three slave stations.

Jaguar Sports Car Faster, Lighter, Quieter

Lighter by 550 lb than the XK 150 S, the new E-type Jaguar has roughly the same power output. It embodies a flexibly mounted sub-frame that damps out transmission noise.

By Gordon Wilkins

THE long-awaited new Jaguar sports car is now revealed. It is a lightweight streamlined low-hung 3·8 litre, 265 hp machine, known as the E-type. There are two versions: open roadster, shown in Fig. 1, and fixed-head coupé, each with combined body-chassis structure in steel sheet and independent rear suspension. Front fenders and hood form a single assembly lifting forward for unrestricted access to engine, suspension, brakes and steering. Body shapes were developed in the wind tunnel and are said to give very low wind drag. The familiar Jaguar grille is gone; there is just a tiny air intake in line with the front bumper.

The roadster is a two-door job with wrap-round windshield, full drop-down side windows and folding top in high-grade mohair. With top folded away, an optional clip-on hard top in plastic can be added. The fixed-head coupé is also a two-door job with conventional doors and a low roof only 48 in high, tapering smoothly into the rounded tail. The rear window lifts for access to the luggage space.

In front of the driver are speedometer and tachometer. Other instruments are on a centre panel with the switches. The three-spoke light-alloy steering wheel has a wooden rim and the steering column length is adjustable.

Power comes from the classic twin-cam six-cylinder engine of 3·8 litres with a light-alloy straight-port head, giving a 9 to 1 compression ratio and being fed from three SU carburettors. It delivers 265 hp at 5,500 rpm, and a maximum torque of 260 lb-ft at 4,000. Ignition is by oil-filled coil and has both centrifugal and vacuum spark control. Transmission is conventional, through a single-plate clutch with hydraulic control and Jaguar's four-speed manual gearbox with synchromesh on the top three ratios. A hypoid final drive with limited-slip differential is mounted on a sub-frame with the rear suspension.

Front suspension is by the familiar Jaguar system of wishbones and torsion bars, with an anti-roll bar. At the rear, the drive shaft with two universal joints but no splines forms one member locating the wheel, and below it is a transverse tubular link. Longitudinal location is by a single radius arm at each side, and suspension is by coil springs with telescopic dampers. The whole assembly, with the differential, is carried on a sub-frame attached to the main structure by rubber mountings, as indicated in Fig. 2 and described in detail later.

Brakes are Dunlop discs with a Kelsey-Hayes servo. There are two master cylinders, giving separate fluid circuits for front and rear in the interests of safety. The handbrake is of the fly-off racing type and there is a brake fluid level warning light. Steering is by rack and pinion.

The power output is approximately the same as has been available to export buyers on the XK150S 3·8, but the E-type car weighs about 550 lb less (2,540 lb or 1,155 kg dry) and has much lower wind drag. The engine has lead-indium bearings throughout and to cut power loss and noise at high speed the fan is electrically driven with thermostatic control. Gearbox ratios are unchanged but the axle ratio is 3·31 to 1 against 3·54 on the XK150S. The centre-lock wire wheels which are standard equipment are 15 in as against 16 in on the XK series, but tyre section has gone up from 6·00 to 6·40 in, so rolling radius is not much altered.

Tank capacity is 14 Imperial (17 US) gallons and main dimensions are: wheelbase 8 ft; track, front and rear, 4 ft 2 in; length 14 ft 7⅛ in; width 5 ft 5¼ in; height 4 ft; and ground clearance 5½ in.

Mounted in line on one side of the front sub-frame are three translucent plastic fluid reservoirs; two with electric level indicators for the two separate brake circuits and one for the operating system of the 10 in Borg and Beck clutch.

The brake servo is a new design, very simple and compact. It is simply a rubber bellows with one end anchored on the scuttle and the other end linked to a rocking beam working directly on the rod from brake pedal to brake cylinders. It is has a large vacuum reservoir tank.

The new standard ratio for the final drive of

Fig. 1 Open-roadster version of the new lightweight E-type Jaguar. Engine capacity is 3·8 litres.

3·31 to 1 gives a speed of about 156 mph at 6,000 rpm on 6·50—15 racing tyres, but designers calculate that on the optional 2·93 ratio the car should do about 174 mph. Other ratios are 3·07 and 3·54 to 1.

One of the outstanding technical features of the design is the flexible mounting of the sub-frame carrying differential, rear brakes and rear suspension. It damps out transmission noise and road vibrations usually noticeable in cars with unit construction and frame-mounted differentials. There are four V-type rubber mountings on top of the sub-frame carrying the weight of the car's rear end. Suspension is by twin coil-spring damper struts at each side—four in all. The light-alloy hub carrier is located by the drive shaft and by a large-diameter tubular link below it, with a broad-based yoke at each end. Fore and aft location is by a stout radius arm of top-hat section at each side. At their forward ends these radius arms are anchored on large rubber discs perforated at two points to make them more flexible fore-and-aft than laterally.

Combination of these mountings and the four above the differential-brake assembly permits a strictly controlled rocking movement of five degrees about the vertical centre line of the differential to absorb drive and braking reactions and prevent transmission of shocks into the body structure.

The car's structure is developed from that on the D-type Jaguar. The basic element is a stressed-skin steel body unit extending from scuttle to rear bumper. Main strength lies in the boxed-in scuttle, the reinforced floor, with centre tunnel and box-section side members, and the rear wings with their inner valances. The same basic structure is used for roadster and coupé, no special reliance being placed on the coupé's light dog-leg windshield pillars and roof panel for extra strength.

The rear sub-frame has already been mentioned. At the front, bolted on to the scuttle, is another sub-frame consisting of two girders and a cross member, all fabricated from square section steel tubes and easily removable for repair. This frame supports engine, steering, radiator and front suspension, and pivoted on it is the front panel assembly which swings forward for access to the engine.

Front suspension, derived directly from that of the D-type, consists of a forged upper wishbone and a lower wishbone made from two forgings bolted together—a stout track control arm supplemented by a diagonal strut. Extending inwards beyond the pivot point is a short end of the track control arm attached to the front end of the torsion bar, so that besides twisting, the torsion bar bends slightly with suspension deflection. On the outer ends of the wishbones are ball pivots supporting the stub axle and brake carrier. Anti-roll bars are provided at front and rear, the rear one being kinked in the middle to clear the propeller shaft.

At first sight the E-type looks long, lean and extremely low, but its ground clearance is an adequate 5 in laden. Entry is quite easy and the curved backrest of the bucket seat gives good lateral support, while a roll on the front of the cushion provides support under the knees.

The acceleration is awe-inspiring, even to people accustomed to the 3·8 litre XK150S. The E-type streaks through the standing quarter mile in 14·8 seconds and chief tester Norman Dewis has regularly done 0 to 100 mph in 16 seconds. The extreme flexibility in top gear gives acceleration from 10 to 30 mph in 5·7 sec, and in the same gear it goes from 80 to 100 mph, also in 5·7 sec; 100 to 120 mph takes only 8·2 sec. In line with this iron-fist-in-velvet-glove performance is the emphasis on silence. Successfull efforts to eliminate road rumble and transmission noise are matched by work on the twin exhaust systems. There are two big silencers under the floor, and twin absorption-type silencers under the kick-up of the tail.

Luggage space on the roadster is limited to room for a couple of suitcases in a shallow compartment above the fuel tank and spare wheel. The coupé carries rather more on a flat platform which is reached by swinging aside the rear window.

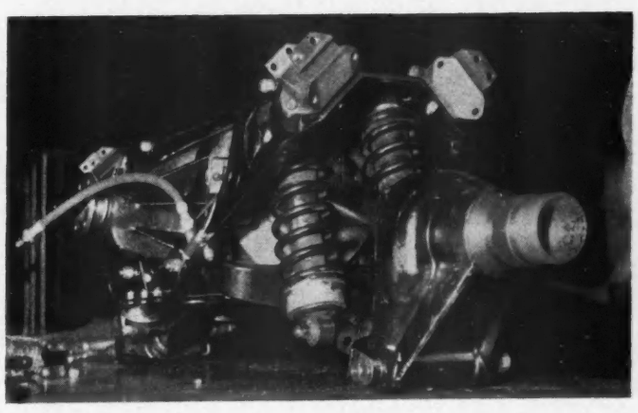


Fig. 2 Rear sub-frame with differential, inboard rear brakes and twin coil-spring damper units at each side. Radius arms are not fitted in this view.

On the Shelf

By Frank H. Smith

I FEEL quite sure that at that Aslib indexing "all-day," somebody gave a figure for the useful life of technical writing as two years. This, of course, is sheer nonsense (as are many of the figures so often taken as gospel) and it was borne out how nonsensical it is when I read the title of an article in *The Engineering Journal* (Engineering Institute of Canada), "Recent Advances in Experimental Stress Analysis," and then saw that the first four items in the bibliography (a quite useful collection of 19 references) were dated 1948.

Quite often I can find something to say about an item without even going past the cover but W. and T. Avery Limited, Birmingham, so successfully put the scales over my eyes with their *Survey* that I had to look quite closely through this interesting booklet of applications of their weighing, counting and testing machines before finding what it was all about. Number 1 gives no indication, that I could see, of its frequency.

I did think that we and the Americans and the Canadians had ironed out any differences in screw threads after the last little fracas in which we were all involved, but in case there still are any differences you may like to get a copy of *Screw Thread Standards for Federal Services Handbook H-28 (1957)*. This is a three-part publication of which part 1 appeared in 1957, part 2 in 1959 and part 3 last year. $1·25, 75 cents and 60 cents respectively, and HMSO will be helped if you quote catalogue Nos. C 13.11.28/3, parts 1, 2 and 3. I'm a devil for the export drive—and anything to cement Anglo-American relations.

In their *Engineering Outlook*, the University of Illinois provide an interesting commentary on engineering interests with an analysis of the latest semester enrollments. Electrical engineering provides 1,178. Next comes civil engineering with 612, mechanical total 604, and then the next highest is aeronautical with 378. Presumably electrical includes electronic but anyway there seem to be an awful lot of straws showing the direction of the wind. Mining is way down with 37, so the call of the Yukon is now pretty faint.

Another dictionary—in five languages. Interscience have published a textile dictionary in English, Polish, Russian, French and German. The editor is W. Fabierkiewicz and the American price is $8. It is interesting to note that the terms are divided as follows: Polish 4470, Russian 4534, English 4870, French 4620 and German 4835. So we just pip the Germans on that one.

An announcement comes from a new firm of publishers (not in "our" category perhaps) and they state their aims in "words of one syllable." Those aims are: "We want to sell books. We want to sell a lot of books." If such frankness disarms, get in touch with Anthony Gibbs and Phillips Limited, 14 Kensington Court, London, W8.

Twelve years ago was the last time *The Author's and Writer's Who's Who* was published. The 1960 edition (Burkes Peerage Limited, Mercury House, 109-119 Waterloo Road, London, SE1) contains 9,000 entries and costs 45*s* ($7).

If you wish to subscribe to the new *Kybernetik*, Lange and Springer, Berlin-Wilmersdorf, Heidelberger Platz 3, are publishing it at DM 12·80 for the first number with 56 pages, of which nine are in English.

The *Unesco Bulletin for Libraries* has a new look and is much, much meatier. Read, especially (Jan.-Feb. 1961), "International Trends in Subject Indexing especially in the Field of Nuclear Energy" and have your eyes opened to the demerits of UDC. Those interested in the Society for the Promotion of Alphabetical Subject Headings should write to me, c/o here, and enclose a blank cheque made out to F. H. Smith.

Giving Engineers a Public Image

Public Relations and Management. By DAVID FINN. *Reinhold, New York; Chapman and Hall, London.* (36*s*)

There are some engineers who have difficulty in reconciling what they believe to be the functions of an engineer with the activities of their own sales department. The job of an engineer, they will say, is to make the stuff. The more thrusting, extrovert members of the club can go out and sell it. Right outside the membership are some highly articulate fellows who make a nuisance of themselves by calling for advertising appropriations. Beyond them again, barely on the fringes of decency, are those who deal in public relations. Were it not that the chairman is said to have truck with them from time to time one would not even know about them. Perhaps I am exaggerating but there is some truth in this description.

The day, however, when it was first admitted that the company was a corporate entity or that the company ought to have a reputation, and a good one at that, public relations was born. From then on, whether we like the idea or not, the question of the public image of the company and the extent to which that image is moulded for public consumption is a question only of degree, of different shades of grey. Those who present the public image (there are varying publics and different images) should therefore have a hearing.

This book has certain clear merits. The author knows he is addressing a prejudiced audience. The fact that it is written mainly for Americans does not reduce its value for the British reader. Some of the illustrations to the argument, and the funniest, have a British context. The book is short and readable like others of the Reinhold series. Because the audience is assumed to be prejudiced, the style is pitched to appeal to the unconverted. The result is both a modest and an honest book. The excesses of public relations work (notably in the entertainment business) are wisely held up to ridicule. The only jarring note is the use from time to time of public relations jargon but the author can be forgiven for these slight lapses from simple English.

The book is not primarily defensive. It sets out to show what public relations can do and what it cannot do. It is practical even to the extent of sketching what public relations activities cost and in what circumstances staff should be hired in preference to outside practitioners.

The author's recommendations, based on practical experience, fit as easily into conditions over here as in the American business world, for which the book was written. It is particularly good, and therefore most disarming, in the sections on the dangers in expecting public relations specialists either to do too much or to do the wrong things. For those who want to know what public relations is all about and who start with the prejudice that it is all stunts and gimmicks, this book is an excellent introduction. Even informed prejudice is an improvement on the other kind.

Public relations are intangible in scope and content and non-measurable in effect. Between the public relations man and the engineer there is therefore a big gulf in work, training and attitude. The present book takes this gap for granted, as a starting point. It may therefore help to fill it.

G. E. TEWSON

Lattice Underlying Engineering

Crystal Growth: Discussions of the Faraday Society No. 5, 1949. *Butterworths Scientific Publications.* (60*s*)

In its widest sense the subject of crystal growth is concerned with all aspects of the ordering process which accompanies the formation of a solid phase, whether from the vapour, melt, or solution, or from the recrystallisation of another solid. Because of the dependence of physical and chemical properties on the atomic structure of a solid there is no branch of science or engineering which is not in some way concerned with crystal growth.

Examples range from the production of metals and alloys with particular mechanical, electrical, or magnetic properties, for growing of synthetic crystals for instrument bearings, for optical systems, or for applications making use of their piezoelectric or ferroelectric properties, to problems concerned with the ageing of refractories, the setting of mortars and cements, ease of filtration in chemical manufacture, and the physical properties of synthetic fibres.

The earliest crystallographic studies were necessarily confined to observations of the external forms of crystals, usually minerals, but these soon led to speculation about their regular internal structure and to the lattice theories of Frankenheim and Bravais (1835-48). The very considerable variations in the types and relative sizes of faces on crystals of minerals suggested that crystal growth is much influenced by external conditions. More detailed studies of crystals of laboratory chemicals have shown that many substances can be grown into quite abnormal shapes such as dendrites and spherulites, in marked contrast to the usual polyhedral crystals, and also that the shapes of some crystals can be greatly changed by the presence of impurities in the solution from which they are grown.

Experimental study of the internal structure of crystals was not possible until the development of X-ray crystallography followed von Laue's discovery of the diffraction of X-rays by crystals in 1912, although Barlow had correctly deduced and illustrated a number of simple crystal structures some thirty years earlier. The theory of the symmetry of crystal structures (space-group theory) had, however, been developed during the period 1885-1894, and it was at first supposed that a perfectly regular structure would extend without interruption throughout a crystal. However, in order to explain the intensities of X-ray beams diffracted by real crystals it was found necessary to assume discontinuities which, in the absence of a physical model, were described by the term mosaic structure. Studies of the luminescence of solids, of electrical conductivity, diffusion in solids, solid-solid reactions, and catalysis, led to the postulation of Frenkel and Schottky defects, while comparisons of the actual strengths of crystalline solids with the calculated values showed large discrepancies which were also apparently to be attributed to departures from perfect internal structure.

Shortages during the Second World War of piezoelectric crystals for electronic devices and of crystals with special optical properties (particularly fluorite) led to renewed interest in the actual techniques of growing synthetic crystals, both from solution and from the melt.

When the Faraday Society planned its first Discussion on Crystal Growth in 1949 it was decided to invite papers on all the aspects mentioned above and the 46 papers presented were grouped into four sections: Theory of Crystal Growth, Nucleation and Normal Growth, Abnormal and Modified Crystal Growth, and Mineral Synthesis and Technical Aspects. Ideas put forward in a number of these papers have since led to very important developments in this field, notably the papers on surface structure by Stranski and co-workers and by Burton and Cabrera, and the paper by Frank on the part played by dislocations in crystal growth.

We need only mention here the recent work on

"whiskers," the very thin filaments of metals, carbon, carbides, etc., which owe their strength to the absence of defects of the kind that reduce the strength of an ordinary solid to a small fraction of its theoretical value. At a diameter of 1μ their tensile strength approaches the theoretical limit, suggesting the possibility of making fabricated materials with tensile strengths appreciably greater than those of the best steels. The reports of work on the growth of piezo-electric crystals and of halide crystals of optical quality were also of great interest at the time of the discussions.

This volume was the first work referred to in the introductory paper by Sheftal at the first Russian Conference on Crystal Growth held in Moscow in 1956. It is also interesting to note that in 1953 the Department of Crystal Physics was set up in Moscow State University to train specialists in the technique of growing crystals, and a special practical course in crystal growth was organised.

The complete set of papers forming *Discussions of the Faraday Society*, No. 5, 1949, has long been out of print, and is now reprinted and published in response to many requests received by the Faraday Society. This book should be in the library of every institution in any way interested in the subject of crystal growth.

A. F. WELLS

Filter Off the Misleading and the Unintelligible

Statistical Theory of Signal Detection. By CARL W. HELSTROM. *Pergamon Press.* (63*s*)

By bringing in complications one at a time, this book provides an introduction to a very large subject. We start with the detection of a known signal, pass to the detection of signals of unknown amplitude, phase and arrival times; then to multiple observations, resolution of signals, and stochastic signals (where the form as well as the parameters is only known in a statistical sense). There are introductory chapters on filters and noise, and the theory of hypothesis testing and parameter estimation is developed along with the theory of signal detection.

The author has chosen a middle position in the range between the practical (and misleading) and the rigorous (and unintelligible). He has not written an engineering textbook ("The engineer may long for a circuit diagram or two" —preface); but he has not introduced rigour for its own sake. Criteria (Bayes, Minimax, Neyman-Pearson, maximum likelihood estimation) are clearly distinguished. Such difficulties as the indeterminacy of the estimated power spectrum of a single signal are plainly stated, and references are given to more detailed treatments; the bibliographies at the end of each chapter extend up to 1958 and include many periodical papers (especially from the American Institute of Radio Engineers publications) as well as books. The 20 page appendix on integral transforms and probability theory might have been omitted; it appears to be an attempt to make the book self-contained, but in such a widely connected field this is an impossibility.

The main emphasis is on the detection of radar and on the analytical mathematics of decision theory—information theory is only mentioned incidentally; but the methods described are applicable (and important) in the detection of signals in general. The level, as the author states, is that of the newly graduated engineer of mathematical bent—the reader must of course have interest in and practical knowledge of the subject if he is to grasp the significance of the information set out.

DRAYTON S. PALMER

Captivator Extraordinary

Michael Faraday: A List of His Lectures and Published Writings. Compiled by ALAN E. JEFFREYS. *Published on behalf of The Royal Institution of Great Britain by Chapman and Hall.* (42*s*)

A recent leading article in *The Times* quoted Gibbon's famous words "it has indeed been observed, nor is the observation absurd, that excepting in experimental sciences which demand a costly apparatus and a dextrous hand, the many valuable treatises that have been published on every subject of learning, may now supersede the ancient mode of oral instruction."

This same thought was put forcefully a little while ago in a book review in ENGINEERING (17 Feb. '61, p. 262) by Mr. D. B. Welbourn, who himself is no mean lecturer. Mr. Welbourn writes "the only difference between civilised and primitive peoples is that the former can read and write," and he concludes that lectures could well be replaced by the "valuable treatises" mentioned by Gibbon. However, Mr. Welbourn differs from the historian in doubting whether there exist many such books. His picture is the gloomy one of an archaic system continuing in use because nobody has had the sense or the energy to refashion it. It is a picture abhorrent to any engineer worthy of the name, something that cries out for reform.

Nor is Mr. Welbourn alone in his strictures on the lecturing system; the undergraduates at Oxford, if the press is to be believed, are up in arms against the low standard of lecturing in that citadel of dons. It looks as if even the lecturers themselves have lost faith in lecturing; one almost seems to catch the mutter of that very remote and ineffectual don, who when asked by his audience to speak up, replied disarmingly: "I am sorry, I did not know that I was being overheard." Small wonder then that that very august body the University Grants Committee is to conduct an investigation into methods of instruction at the universities.

But most questions have two sides to them. Many of us have fallen asleep in bad lectures, but sleep under such circumstances is likely to be disturbed by periods of wakefulness, whereas sleep induced by books will continue until the fire has gone out in the grate and we awake stiff and wretched with the valuable treatise still open at page 3. There is much to be said for lectures and in a country that believes in government by talking lectures should not be lightly abandoned; instead the standard of lecturing might well be improved.

This certainly would have been the opinion of that prince of lecturers and patron saint of electrical engineers, Michael Faraday, whose lectures and published writings have been listed in a beautiful volume by Mr. A. E. Jeffreys. On the dust cover of this book there is a reproduction of a page of Faraday's lecture notes. The title is "Electrical Forces" and the notes alone make exciting reading.

Part of the lecture deals with the conduction of electric current and Faraday writes that there is nothing more extraordinary than the power of conveying electricity possessed by some bodies There is here that sense of wonder which is the mark of a great lecturer. "Extraordinary," says Faraday, and one can see all heads raised and eyes wide open. "Just Ohm's law, perfectly obvious," says another lecturer, and his audience sinks into a heavy stupor.

What made Faraday such an outstanding lecturer? The Royal Institution has published a booklet giving his advice to lecturers, but example is better than advice. Anyone wanting to observe the master at work should read his lectures to children on "The Chemical History of a Candle." Children are the best judges of lectures and they do not leave the lecturer in any doubt about their reaction. Faraday was a simple man as well as a great one and he loved lecturing to children.

Lucid, humorous without any form of pompous condescension, his lectures carried the audience along with the deep thoughts of the lecturer and one ventures to think that those young people learned more in an hour from Faraday than they would have done in three years from wading through the *Decline and Fall*. The "ancient mode of oral instruction" in Faraday's use of it achieved its object superbly. Would it be mischievous to suggest that dons wishing to lecture, whether on nuclear energy or Egyptian antiquities, should pass a test first by giving a course of lectures at the local secondary modern school? It is surely worth a trial.

P. HAMMOND

Bridge Between Two Cultures

A Short History of Technology. By T. K. DERRY and TREVOR I. WILLIAMS. *Oxford University Press.* (38*s*)

Many who read the magnificent five volume *History of Technology* sponsored by ICI and published by the Oxford University Press felt that an abridged version, within the price range of schools and general libraries, should follow it. Here, at a remarkably low price, is just such a book, again subsidised by ICI.

It is, however, more than a mere abridgment; although obviously drawing freely on the larger work, it is itself newly written. To some extent it answers one of the criticisms of the former in that it includes two chapters of background social history, each of which precedes one of the two periods into which the book is divided, and a short epilogue on the relation between technical and general history.

As the authors point out, this is a new subject and one that still contains many puzzles. Not only are the processes by which man first became a tool-using animal unknown, but also the origins of the development of such inventions as the wheel, the sail, the loom and the kiln, which converted Neolithic barbarism into the earliest civilisation.

Even the origins of such comparatively recent innovations as the first artificial prime movers, the water-mill and the windmill, as well as other contemporary inventions, are not satisfactorily accounted for. Only now are we beginning to learn something of the debt which Europe owes to the early civilisation of China, many of whose advanced products and processes percolated slowly into Europe through Arabia.

These gaps may now come to be filled as the study of the history of technology begins to find

a place in universities and colleges of technology. Taught not as a mere chronological description of the development of implements and processes, but as a fundamental aspect of social history, it can provide an invaluable bridge between the students of the arts and those of the sciences. Sir Charles Snow has pointed out the danger to our society of its educated men and women being brought up in two separate cultures: the one almost entirely scientific and technological and the other without understanding of the basic physical laws of the Universe or of the technoligical principles on which the economy is based.

Although this book is mainly descriptive, its authors are clearly aware of the wider purposes which the study of their subject should be made to serve.

Handsomely produced and illustrated it should find a place in the library of every secondary school, where it should play a useful part in encouraging young men and women to become engineers or industrial scientists.

AUSTEN ALBU

Uncharged Particle Hard to Recognise

Neutron Detection. By W. D. ALLEN. *George Newnes.* (45*s*)

It is almost 30 years since the discovery of the neutron, and throughout that period the success or failure of neutron experiments has depended to a large extent upon the detection techniques. Neutrons have a long mean free path through matter relative to other particles and this means that they are relatively difficult to detect. In addition, one cannot observe neutrons directly and thus detection techniques frequently involve a nuclear reaction in which the neutron is lost and the event is observed through the ionisation caused by a charged particle or gamma-ray released in the interaction.

Clearly this method is not too efficient. But for low neutron energies it is the only one available. At high neutron energies the recoil of charged particles struck by the neutron can be seen, but the efficiency of this method is not high either. Another difficulty is that in most practical cases neutrons must be detected against a background of other radiation (principally gamma-rays).

All these factors make it difficult for the experimentalist to be sure that he is detecting neutrons, that he knows their energy and that he is doing it efficiently. And thus there has been a constant quest for improved methods of detection, which has led to an immense variety in both principles and techniques. Even since this book was prepared two new and valuable techniques have appeared. One is the solid-state (or semiconductor) detector and the other is a scintillating lithium glass. Both these devices have high resolution and pulse height.

It is therefore very appropriate that a complete book should be devoted to this subject. Indeed it is a necessity for people entering the neutron field, because in assessing a neutron experiment it is very important to keep a range of detection techniques in mind.

This book is written mainly for those physicists who, after experience in other fields, are turning to neutron experiments. Nevertheless it is valuable too as a source book for those already in the field.

On the whole it is written in a lucid style, and is very "readable." There are twelve useful appendices giving such practical information as neutron cross sections, range energy relationships and decay schemes. Dr. Allen has laid out his material in a convenient way, so that each chapter follows on easily from the last. The level of presentation is more or less uniform throughout. Most of the material is descriptive in character. However, no one technique is covered in detail and for such information the reader is provided with a bibliographical list (there is one for each chapter).

The publishers are to be congratulated also on the printed layout and the general production; it is a good book from this point of view. I am sure it will meet an important need and is worthy of recommendation to all neutron physicists.

P. A. EGELSTAFF

New Books

Whitaker's Almanack, 1961. 93rd Edition. *J. Whitaker and Sons.* (21*s*)

One of the largest editions of *Whitaker* ever, this edition includes details of the new pension scheme; notable legislation of the past year including ticket fines for road offences, payment of wages by cheque, and local employment; and the whole mass of information that goes to make it a self-contained reference library.

Directory of Railway Officials and Year Book, 1960-1961. 66th Edition. *Tothill Press.* (60*s*)

The pace of railway developments has necessitated more numerous changes than usual. The last steam locomotives were withdrawn from Canadian National and CPR early last year, while in Great Britain the last railway-built steam locomotive—the *Evening Star*—emerged from Swindon Works in March, 1960. Details of railway undertakings and their officers are followed by the invaluable alphabetical list of personnel.

FBI Register of British Manufacturers, 1961. 33rd Edition. *Published for the Federation of British Industries by Kelly's Directories and Iliffe.* (50*s*)

Nearly 8,000 member firms have contributed to the present edition, and their products and services are listed under some 5,400 alphabetical headings. There are glossaries in French, German and Spanish.

Electricity Undertakings of the World, 1960-61. 70th Edition. *Benn Brothers.* (35*s* 6*d*)

Details of UK power stations, area boards, and service facilities; personnel of EC, CEGB, and area boards, and information on supply authorities and their services in the Commonwealth and elsewhere overseas. Additional material has been forthcoming this year from a number of foreign companies.

The World of Learning, 1960-61. 11th Edition. *Europa Publications, 18 Bedford Square, London, WC1.* (140*s*)

Following a section on Unesco and the principal international scientific, educational and cultural organisations, the main part of the book provides detailed information about academies, learned societies, research institutes, libraries and archives, museums and art galleries, universities, colleges and technical institutes throughout the world, in alphabetical order of countries.

Jane's All the World's Aircraft, 1960-61. Compiled and edited by JOHN W. R. TAYLOR. 51st Edition. *Sampson Low, Marston and Company.* (105*s*)

In spite of the disappearance of famous names as a result of mergers, and a decreasing number of new military designs, there are more new aircraft than ever included in this edition. In a record number of pages, one notices the expected increase in coverage of guided missiles, and also a rather more surprising increase in airships.

Jane's Fighting Ships, 1960-61. Compiled and edited by RAYMOND V. B. BLACKMAN. 63rd Edition. *Sampson Low, Marston and Company.* (105*s*)

In Great Britain, HMS Hermes was finally completed and joined the fleet as an operational aircraft carrier last summer, and the Ark Royal rejoined after refit. The cruiser Lion, laid down as long ago as 1942, was completed during the year, and on 21 October Britain's first nuclear powered submarine, HMS Dreadnought, was launched.

Hotels and Restaurants in Great Britain and Ireland, 1961. 33rd Edition. *British Hotels and Restaurants Association, 88 Brook Street, London, W1.* (2*s* 6*d*)

Particulars of hotels, both licensed and unlicensed, and licensed restaurants, which are members of the Association, including size, situation, amenities and tariffs. A useful section of road maps is appended.

BBC Handbook, 1961. *British Broadcasting Corporation, Broadcasting House, London, W1.* (6*s*)

Progress in the development of VHF coverage has reached the point where in 1960 twenty stations were in operation, covering over 97 per cent of the population. This incidentally has made it possible to introduce "area broadcasting" whereby items of local interest are broadcast from stations covering part of a region.

The Reviewers

Mr. G. E. Tewson, M.A., is a partner in the firm O. W. Roskill Industrial Consultants.

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Mr. D. S. Palmer, M.A. (Cantab) is section chief (analytical statistics) at Marconi's research laboratories, Chelmsford. His academic training embraced mathematics and mediaeval history, and he is a fellow of the Faculty of Actuaries (Scotland).

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Mr. Austen Albu, B.Sc., A.M.I.Mech.E., M.I.Prod.E., M.P., is a member of the House of Commons combining professional engineering qualifications with membership of the Amalgamated Engineering Union.

Dr. P. A. Egelstaff is employed in the Nuclear Physics Division of the Atomic Energy Research Establishment, Harwell.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Plant

Jaw Breakers. HADFIELDS LTD., East Hecla Works, Sheffield 9. Sledging and solid steel types of jaw breakers; full details of sizes and construction with curves of performances given in publication 470. 28 pp. ill.

Rod Decks. INTERNATIONAL COMBUSTION PRODUCTS LTD., 19 Woburn Place, London, WC1. Ty-Lock rod decks for Ty-Rock mechanical screens. Publication G 601, 44 pp, ill.

Oil Country Equipment. NIAGARA SCREENS AND PLANT LTD., Straysfield Road, Clay Hill, Enfield, Middlesex. Mud tanks, shale tanks and rumba shakers for oil fields. 6 pp, ill.

Gyratory Crushers. ARMSTRONG WHITWORTH (METAL INDUSTRIES) LTD., Close Works, Gateshead-on-Tyne 8. Kue-Ken gyratory crushers standard range up to 36 in. Full details with section drawings in publication 121B59. 12 pp, ill.

Spray Booths. T.C. SPRAY FINISHING SYSTEMS (BEDE) LTD., 5 St. James's Place, London, SW1. Unit system spray booths for fitting to any line. Wet and dry types. 4 pp, ill.

Heat Exchangers. WHESSOE LTD., Darlington. Fixed tube, U-tube, and floating head heat exchangers, all sizes. Design and performance figures given in brochure, with cost factors and installation notes. 16 pp, ill.

Cooling Towers. HEAD, WRIGHTSON & CO. LTD. 20 Buckingham Gate, London, SW1. Low head cooling towers for small industrial duties; various types. Folder 6 pp, ill.

Paper Maturing Machine. STURTEVANT ENGINEERING CO. LTD., Southern House, Cannon Street, London, EC4. Controlled high speed paper maturing machine; speeds up to 800 ft per minute with 5 per cent moisture regain. Folder, 4 pp, ill.

Marketing

Australian Growth of Metal Industrial Group

WIDENING its Australian activities METAL INDUSTRIES have bought the New South Wales engineering electrical group, ALCOL HOLDING Pty.

Alcol Holdings own the ALAN COLLESS and DESIGNED CONTROL AND MANUFACTURING companies, all three operating from a works at Silverdale, near Sydney.

The main business of Alan Colless is the Australian sale of the products of BROOKHIRST IGRANIC Limited, the major electrical engineering subsidiary of Metal Industries. Designed Control and Manufacturing produce control gear based on components made in England by Brookhirst and imported by Alan Colless.

In November last year, Metal Industries amalgamated its subsidiary LANCASHIRE DYNAMO COATES Pty, of Melbourne, with GODFREY ELECTRICAL INDUSTRIES Pty of Sydney, by the establishment of a new company, M.I. AUSTRALIA Pty, to take over both concerns.

British Industry and the Mexican Market

The Engineering Centre, which in recent years has organised group stands at British trade fairs in Brussels, Lisbon and New York, is preparing to run another group stand, at the "British Equipment for Mexican Industry" exhibition to be held in Mexico City later this year.

Depending on the amount of support for the group stand the cost for firms taking part will be between £8 and £10 per sq. ft. This will cover not only the overall shell for the stand but arrangement of transport and shipping from factory to exhibition and back, the necessary paper work and tariffs and customs.

The Mexican exhibition is being sponsored by the Dollar Exports Council and the Federation of British Industries. The Engineering Centre will be assisted in reserving enough space if firms interested in the Mexican market will write as soon as possible to the general manager of the centre, at Stephenson Place, Birmingham 2. The exhibition is to run from 29 September to 15 October.

Marconi Image Amplifier Crosses Atlantic

One unit of the Marconi X-Ray Image Amplifier has been installed in the Toronto general hospital, Canada, a second unit is to leave England shortly for Montreal and other orders have been received from hospitals in Halifax and Winnipeg.

The X-Ray image amplifier presents the image of the part under examination on large television monitor screens. Details can be seen clearly in normal room lighting, cutting out time wasted in adapting to dark conditions. The patient is said to be exposed to a smaller amount of radiation than in conventional screening methods.

Executives of X-RAY AND RADIUM Limited, of Toronto, North American agents for the amplifier, which is made by MARCONI INSTRUMENTS Limited, of St. Albans, Hertfordshire, were recently in Britain. They believe that more than 100 of the units can be sold in North America, a sales volume of well over £1 million. From the United States firm inquiries have been received from Philadelphia, Boston, New York and Miami.

Electronic Control of Swedish Air Defence

Secret electronic equipment worth £1,700,000 for the Swedish air defence system is to be supplied by the MARCONI WIRELESS TELEGRAPHY Company. The order follows substantial contracts of two years ago.

The Marconi system has at its centre a computer working at very high speeds solving interception problems and making it possible for the fighters and guided missiles of the defence system to be brought into action at the right place and time. Black and white television and colour projection are used alongside automatic information dissemination techniques. There are some 500,000 transistors and diodes and 15,000 valves in the equipment.

An early warning radar chain gives the height and position of aircraft. These figures are fed to special radar indicators incorporating automatic tracking devices. From an information bank, data is fed to synthetic displays at positions manned by controllers and other officers who are able at the press of a button to obtain selected categories of information.

A "Magic Carpet" device uses a radar picture to show the numerical composition of a formation of aircraft. Targets displayed for analysis are presented automatically in a queue which can be broken into if a priority demand has to be handled.

Marconi explain that in the event of an attack the senior control executive would decide on the action to be taken using the information available. From the first scrambling order, the computer is fed with information on the enemy and on the opposing fighters from the information bank. It calculates the interception path, taking in pre-programmed information on the characteristics of the fighters, revising its calculations as fresh information is fed in from the memory store. Orders are transmitted to the fighters without human intervention.

The system also provides for remote synthetic displays for the civil defence organisation, civil air traffic control centres and other bodies.

New AEI Department for Rectifier Engineering

ASSOCIATED ELECTRICAL INDUSTRIES have combined their rectifier engineering and semiconductor engineering departments into a single new department which is to be known as the power rectifier engineering department.

The former manager of the rectifier engineering department, Dr. J. C. Read, is to become divisional consultant on rectifiers. Mr. W. D. Sinclair, who has been manager of the semiconductor engineering department, becomes manager of the new department.

Door to Door for Leipzig Fair

Preparations for the International Fair which opened in Leipzig on 5 March included the major exploitation by British exhibitors of road delivery facilities between the United Kingdom and East Germany.

BRITISH ROAD SERVICES contributed 23 vehicles, of ten to fifteen tons capacity, to the fleet of lorries taking part. Deliveries averaged six to seven days from the time of loading at the factory or the salesroom and some loads made the journey in only five days.

Machine tools made up the greater part of the traffic but woodworking and textile machinery were also carried with mechanical handling equipment, sintering and brazing machines, scientific instruments, wines and spirits and the exhibition stands themselves.

Three main factors have led to the swift spread of the door-to-door road transport services, which use ferry ships across the Channel specially designed for ease of driving on and off. They are, the simplicity of loading up at the start of journey and not unloading again until the destination is reached, the relative speed of this method and the reduction in the cost of packaging needed.

The journeys to the fair were mostly made through Antwerp to Dusseldorf, Essen, Dortmund and Braunschweig. The East German authorities directed Leipzig bound traffic to cross the border between Helmstedt and Magdeburg, the quickest route available.

Overhead Monorail for Winfrith Heath

Fissile materials at the new Winfrith Heath establishment of the UNITED KINGDOM ATOMIC ENERGY AUTHORITY are to be handled with the aid of a completely automatic remotely controlled monorail installation. The Authority have placed a contract for the design, production and installation of the system with BRITISH MONORAIL Limited, of Brighouse, Yorkshire.

Remote selection of material from seven assembly bays in the fissile material stores is possible with the installation. Delivery will be to twelve experimental stations in the reactor physics hall. Electric hoists suspended from powered carriages will pick up and transport the loads.

Shafting Records in North East Colliery

All the standing records for shaft sinking in the United Kingdom have been recently broken by the THYSSEN SHAFT SINKING Company at the Kellingley Colliery project of the National Coal Board in the North Eastern division.

During January, 338·97 ft of 24 ft diameter shaft were completed involving the excavation of more than 7,000 cu. yd of solid rock.

The earlier records were held by KINNEAR MOODIE and Company who sank the Parkside shafts in conjunction with South African engineers. The former four week record had also been established at Parkside. Thyssen's broke this between 2 and 29 January by sinking 297 ft and lining 320 ft with concrete. The Parkside record had been 282 ft sunk and 285 ft lined. The company also broke the previous five week record, set up at Parkside, by rather greater margins.

Thyssens employed three shifts, using ten Holman Silver Three Handrils. At an early stage in the operations, considerable difficulty in withdrawing the drill steels was experienced as the work progressed through "frozen ground." After consultation with HOLMAN BROTHERS, of Camborne, Cornwall, the Handrils were converted to allow high volume independent blowing which overcame the problem.

Two 24 ft finished diameter shafts are being sunk by Thyssens at Kellingley, which will produce about 6,000 tons of saleable coal a day when in full production. This should be achieved before the end of 1964.

Hawk Missile Launchers for Nato Forces

The United States NORTHROP CORPORATION, of California, a major industrial participant in the support of the NATO forces, has received a further order for the continued production of mobile launchers for the US Army Hawk surface-to-air missile.

The Hawk is in service with the United States Army and Marine Corps and is to go into use with NATO forces. It was recently successful in trials against the United States' Corporal missile. The Hawk has destroyed three different surface-to-surface ballistic missiles of the type now envisaged as typical of the weapons that could be expected to be used against ground forces. Its three victims were the Honest John, the Lacrosse and the Corporal.

Northrop are responsible for the design of the missile's airframe, and the design and production of the mobile launchers, self-propelled missile loaders and associated ground equipment and airframe components.

Companies in France, Italy, the Netherlands, West Germany and Belgium are producing the Hawk for NATO.

Clearing Presses for General Motors-Holden

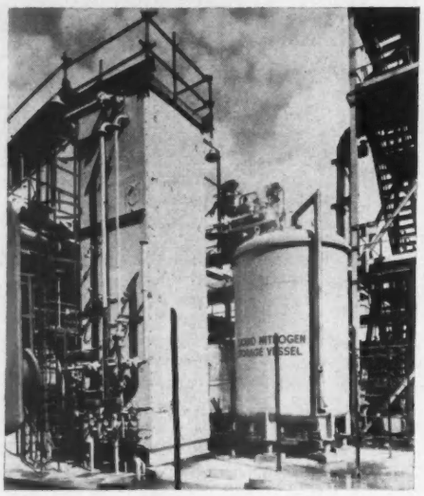
GENERAL MOTORS-HOLDEN of Australia have placed a £650,000 order for clearing presses with US INDUSTRIES (GREAT BRITAIN) Limited, part of which will be carried out in Britain and part in Australia.

In England, three large double action presses, with a total value above £250,000, will be manufactured under the normal arrangements with VICKERS-ARMSTRONGS (ENGINEERS) Limited, at Newcastle.

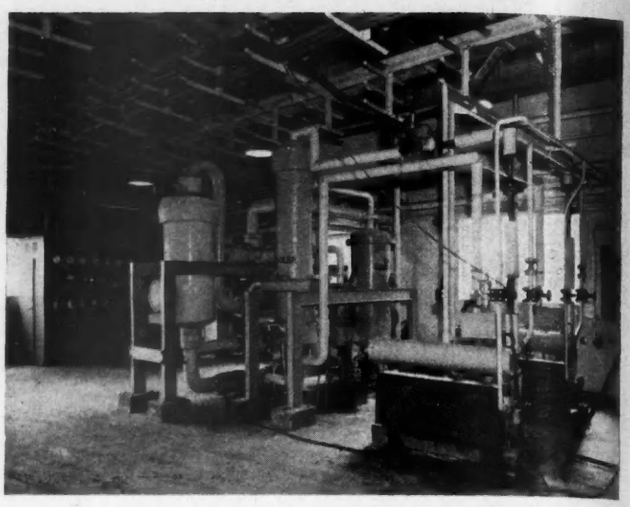
In Australia, seven large single action presses and four welding presses, worth together more than £400,000, are to be produced under the agreement with VICKERS-RUWOLT (PTY) Limited, at Melbourne.

Ultrasonic Scaling Gear for 15 Soviet Tankers

Ultrasonic boiler scaling equipment for the boilers of fifteen Russian tankers now being built has been ordered by the Soviet authorities from H. N. ELECTRICAL SUPPLIES, of Rochelle Works, London, SW2. The company specialises in the production of Crustex Descaling equipment.



(Left) The UKAEA's high purity nitrogen plant showing the cold box and liquid nitrogen storage vessel.



(Right) A view of the plant showing the air drying system and control panel.

Producing High Purity Nitrogen

In recent years, there has arisen a significant demand from a wide range of industries for moderate quantities of pure nitrogen. These demands have been large enough to render uneconomical the transport from a distance of compressed gas in bottles or liquefied gas in tanks. On the other hand, however, conventional methods of producing nitrogen on site are not always satisfactory.

Plants based on the combustion of fuels and the subsequent purification of the flue gases show a high cost of utilities and it is difficult, with such plants, to guarantee a purity of 99·9 per cent and over. Normal double-column air separation plants, using high pressure multi-stage compressors and reciprocating expanders, give rise to occasional maintenance troubles. Moreover, the nitrogen is delivered at atmospheric pressure. If the nitrogen has to be recompressed for storage or for use, additional compressors have to be installed so that, unless special precautions are taken, the initially pure product may easily become contaminated. The production of nitrogen in 100 per cent liquid form is uneconomical in power consumption.

Thus it was that when the United Kingdom Atomic Energy Authority needed a supply of high purity nitrogen at an elevated pressure, Petrocarbon Developments Limited decided that only an entirely new approach could give a satisfactory solution to the problem. Based on the experience gained from earlier work on the use of expansion turbines in connection with oxygen and argon plants and the distillation of hydrogen for the separation of deuterium, they developed a new series of fully automatic plants to satisfy this demand.

The newly developed plant, which is simple to start up and requires virtually no operator attention, has been in successful operation over an extended period in one of the installations of the Production Group of the UKAEA.

The high purity nitrogen is produced by the fractionation of air at low temperatures in a single column operating at 100 lb per sq. in, and is delivered direct to the consumer at this pressure. Compression of the product, with consequent risk of contamination, is thus unnecessary. The purity of the nitrogen is normally 99·99 per cent, but still purer gas can be supplied on request.

The air is compressed to 110 lb per sq. in and passes through the purification system and heat exchangers direct to the column without expansion. The low temperatures are maintained by expanding a part of the compressed air, after its passage through the column, in a turbine of novel design rotating on air bearings at 60,000 rpm.

The capacities of the present series of plant range from 4,000 to 40,000 Ncu. ft per hr of nitrogen, though larger units can also be provided.

The output of a plant varies automatically with demand from zero to the upper limit and power consumption is reduced when the offtake diminishes. If no nitrogen is consumed, the plant will tick over with a minimum consumption of power and will automatically come on stream again when consumption is resumed.

For emergency storage and to cover short periods of peak demand, up to 10 per cent of the product can be delivered as liquid and is then passed to a large and very well insulated storage tank. If then the momentary demand for gas exceeds the productive capacity of the plant and if, as a result, the pressure in the user's pipe line tends to fall, liquid nitrogen is automatically discharged from the tank and vaporised, restoring the pressure to normal and permitting an increased offtake as long as liquid remains in the tank.

Should the purity of the product at any time fall below the desired value, production ceases automatically, thus preventing impure nitrogen from entering the user's supply line. The plant then runs on total reflux until the purity is restored.

The consumption of utilities per unit of nitrogen product varies with the capacity of the plant and with the degree of purity required. For a unit delivering 12,000 cu. ft per hr, the power consumption is approximately 120 kW and the cost of the nitrogen, excluding liquid storage facilities, the extent of which depends on the user's requirements, is found to be about 2*s* 5*d* per thousand cubic feet, inclusive of depreciation and reasonable maintenance charges. This cost figure is an estimate and is not based on operating cost data supplied by the UKAEA.

Wood Screws Cold Flow Formed

Crossley Brothers Limited of Manchester are manufacturing and selling a machine developed by the Trurnit Company of Germany which produces wood screws by a cold flow forming process. The machine, called the Crossley-Trurnit precision screw thread hammering machine, represents something of a revolution in wood screw manufacture. In operation, a screw blank is slowly rotated in the machine and hammered, at a rate of up to 6,000 blows a minute, by rotating dies operating radially inwards and encircled by a hollow cam wheel.

Material savings are expected in cold flow forming processes. In this case they amount to between 15 and 20 per cent, compared with conventional metal removing processes. There are savings in labour costs too, because the thread hammering process is much quicker than a thread cutting process. However, this is not so important as the saving in material because the labour content of the final cost of wood screws is already very low.

Technically, screws produced by the new process are claimed to be superior because the material has a favourable grain flow undulating up and down the threads, as compared with the broken grain flow of cut threads. In addition, the material is work hardened in the hammering process and the finish is good.

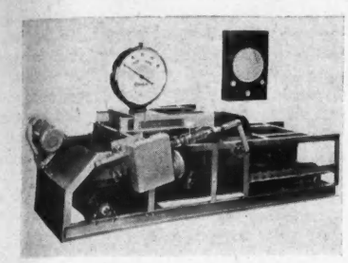
A wood screw not only has a point at its tip. It also has the start of the screw threads. This presented a problem long after the hammering of the parallel part of the screw had been successfully accomplished. The key to success in the development of this process lay, in fact, in two secondary developments. The first of these was a separate " pointing machine " which machines a point on the tip of the screw and then cuts a screw thread on this tip. This completes the work of the pointing machine which has a very high rate of output. The second development was the means whereby the partly machined blank is then fed into the screw thread hammering machine in such a way that the thread on the tip of the blank is successfully picked up and continued along the length of the screw.

Both the pointing machines and the screw thread hammering machines are fed from overhead hoppers and finished screws are produced at a rate of one to three seconds a piece according to size. The pointing machines have a higher rate of output than the hammering machines, and ideally the manufacturing unit should comprise multiples of two pointing machines to three hammering machines. This gives the most favourable ratio of capital cost to quantity of screws produced, although, for smaller outputs, one pointing machine to either one or two hammering machines could be used.

The process is quite different from thread rolling where blanks of reduced diameter (as opposed to blanks of reduced length in the hammering process) are used and the material swells up to a larger outside diameter without change of length, the blank being constrained in the lengthwise direction by the threaded rollers. Screws with a big pitch and deep threads are suitable for forming by hammering but they are unsuited to thread rolling.

Improved Grinding Mill Output

A new constant weight feeding system, equipped with a proportional action controller, allows grinding mills to operate at maximum capacity. Normally, a hopper discharger feeding, say, a 40 ton per hour grinding mill has to be set so that its output never exceeds 40 tons per hour; otherwise the mill would be overloaded. This means that, because the density of the material being handled varies by as much as 20 per cent, the hopper discharger must be set so that its average output is only 36 tons per hour, or 4 tons less than the capacity of the mill.



The package control system which makes grinding mill output independent of variations in density of feed.

To eliminate this wasted capacity, the new feed control system has been developed by Richardson Scale Limited. Their system frees output from the effects of variations in bulk density. The proportional action controller, supplied by Honeywell Controls Limited, continuously adjusts a power cylinder on the hopper discharger, to keep the feed constant and equal in weight to the maximum capacity of the mill. This instrument may be sited up to 300 ft away from the feeder; so that it is possible for a number of feeders to be controlled from a central control panel. The controllers are of the recording type and provide permanent records of actual performance for routine checking, cost accounting and other purposes.

The system can be supplied as a complete package unit including all instruments, driving motor, starter, and so on. Alternatively, the control system only can be supplied for use with existing conveying systems.

Tape Control Without Mistakes

The first demonstrations in the United Kingdom of the EMI controlled Droop and Rein FS 80 N vertical milling machine took place last month.

The most notable feature of this machine is the facility, called the " angle safety unit," which foresees any programme irregularity or error in the tape and stops the machine before the work piece is damaged. Previously, tape controlled machines were equipped with a safety system which stopped the machine immediately after an error had been made—too late in many instances.

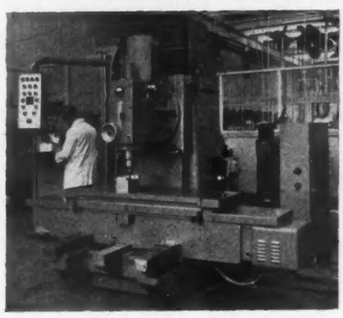
Droop and Rein, the German machine tool manufacturers, have been making, drilling and milling machines since 1890, but this is their first tape controlled machine. It is a general purpose machine tool, particularly suitable for large die sinking because it is heavy and robust, and has a wide range of controlled movements.

The table is fully supported along almost its entire length; the bed has widely spaced slideways and the recirculating ball lead screws are centrally positioned. All these factors help preserve the accuracy of the control system. Hardened and ground gears give low backlash, low friction and long life. The machine is equipped with electrical servo-drives and measuring units in three axes—table, bed and headstock.

The Emicon system, as fitted to this machine, gives continuous contour control in any two axes and fine step control with controlled feed speed in the third dimension. This feed can be independently set for " in " or " out " movements. A fully three dimensional control system can however be fitted if required. Zero shifts are provided on all axes to facilitate the accurate positioning of the workpiece and reduce setting up time. The input programme can be corrected for the actual size of cutter in use, even after a regrinding operation during the course of cutting a workpiece.

The angle safety unit can be incorporated in all those EMI controlled contour cutting machines which have this means of compensating for variations in cutter size. It derives its control information from the built-in computer that controls the machine, and since it continually has access to the computer output before it is used to control the machine, it is able to predict a fault and stop the machine before it follows the mistake.

In the EMI system of machine tool control, coordinates of suitable points on the contour to be cut are considered by the programmer in groups of three consecutive points. These groups are known as spans: they do not overlap



The tape controlled vertical milling machine incorporating the angle safety unit.

but they do have common end points. The equipment interpolates a smooth curve passing through each group of three points calculated by the programmer.

Now, many contours are smooth throughout and thus consecutive spans are arranged by the programmer to blend tangentially into each other. If one of the three points forming a particular span does not lie on the smooth contour, the junction between the preceding span and this particular one becomes a sharp corner whose contained angle depends on the degree of offset of the point which is not on the contour and which, therefore, is causing the corner.

Among the control equipment, there exists a rotary device called a resolver, the angle of whose shaft is continually indicating the angle of the surface of the contour at the point being cut. It does this by sampling the commanded displacement of each axis over a very short length of time. Samples are continuously being taken of how much the machine has just been told to move and of how much it is going to be told to move.

If, therefore, the angle of the surface changes suddenly by more than a preset amount due to an offset point, the advance information sample immediately detects the transient and trips the safety circuits.

When the programmer wishes to insert a sharp corner, he must also insert a corner code in the programme at that point. This is used by the equipment to inhibit the angle safety unit.

Pneumatic Descaling Tool

A new hand tool manufactured by Etablissements Barthod of Lyon, France, can be used for many descaling jobs which would otherwise necessitate sand blasting. The tool can be used for removing rust, scale, paint and the like from metal surfaces and also for cleaning the facades of buildings.

The tool is powered by compressed air. Its handle houses a control and distributing valve assembly which is connected to a nest of special tubes, each containing a striker and a removable tip. This multi-spindle element provides the percussion medium. The tips mate with the shape of the area being descaled and the strikers actuate the spindles. A wide range of impact rates is available, from light to heavy. These are used according to the nature of the material to be removed in such a way as to avoid harming the treated surface.

Aluminium Stud Welding

A new technique has been devised for stud welding to aluminium alloys which minimises porosity and atmospheric contamination.

Recent tests carried out by Crompton Parkinson (Stud Welding) Limited on the cast metal produced by an aluminium stud weld showed that it suffered from impurities derived partly from the film of oxide and partly from the residue of a drawing lubricant on the stud, and was further aggravated by atmospheric contamination during the weld cycle. The film on the stud was removed by skimming it on a lathe. Contamination was dealt with by excluding the normal atmosphere and substituting argon in its place.

The inert gas is introduced and contained in the weld zone through a brass shroud which goes around the stud and ferrule in the weld position. A valve attachment at the base eliminates gas wastage by releasing the argon flow only when the tool is in position. The use of the argon attachment has been proved to be successful for the complete range of aluminium alloy studs up to and including $\frac{7}{16}$ in diameter.

On $\frac{1}{2}$ in studs, the complete prevention of porosity set a greater problem, and to overcome the slight reduction in strength caused by

The use of an argon shroud in aluminium stud welding minimises porosity and atmospheric pollution.

microscopic porosity, the weld base area was, in effect, increased. This was done by making use of the metal displaced when the stud is returned to the molten pool. Investigations showed that fusion did not occur between the displaced metal and the stud sides because the stud periphery was too cold. This led to the development of a preheat arc unit. A current of about 70A and a duration of about 3 seconds give the desired conditions for a $\frac{1}{2}$ in alloy stud.

With the exception of the argon attachment and the preheat arc unit, the rest of the equipment is standard. The technique will be demonstrated on the Crompton Parkinson stand at the Engineering, Marine, Welding and Nuclear Energy Exhibition beginning on 20 April.

Low Noise for Microwave Communication

Developments in radio communication and radar are largely dependent upon the intrinsic noise of the receiver. Two of the most promising low-noise devices to appear in recent years have been the maser and the parametric amplifier.

ONE of the tasks currently engaging the attention of the staff at the Marconi Research Laboratories is the study of amplifiers with low noise characteristics. At microwave frequencies the limiting factor on the detectability of signals has always been imposed by the radio noise generated in the amplifier itself, while sources of external noise, such as the "atmospherics" which were well known in the early days of broadcasting, have been of little importance. There has, however, been a steady advance toward the development of the ideal receiver in which internally generated noise is insignificant so that a signal is, with sufficient amplification, always detected provided that its magnitude exceeds that of the noise entering the receiver from the aerial.

It is convenient to define the noise characteristics of a receiver in terms of a "noise temperature." The noise temperature of a receiver is said to be T° K when the noise generated internally is equivalent to that from a resistor which is maintained at temperature T and matched into the input stage. A receiver with noise temperature zero would therefore have no internal noise and the ratio of signal to noise at its output would be exactly that at the input. In a similar manner the temperature of the "sky" as seen by the aerial to which the receiver is connected may be defined in terms of the noise which is received at the receiver input terminals from external sources such as the sun, radio stars, atmospheric disturbances, etc. In general, the objective in receiver design is to reduce the receiver noise temperature to below that of the sky, although the requirement will, of course, differ according to circumstances.

For example, a radar station will in general be interested in detecting targets at low angles of elevation as well as those at high altitudes and its cover must therefore extend down to ground level. In these circumstances it will pick up ground sources of noise which include not only the earth itself (which acts as a resistor at about 300° K poorly matched into the receiver) but also the atmosphere viewed at oblique incidence, i.e. over a long path. In these circumstances an effective sky temperature of perhaps 100° K might be realistic. On the other hand for communication by satellite it will be possible for the aerials of the ground stations to be directed high into the sky and away from the earth and a sky temperature of about 10° K would then be possible. The type of amplifier used will therefore be depedent on the application.

A number of amplifiers with characteristics approaching the ideal are now available. At frequencies of up to about 1,000 mc/s the thermionic amplifier in the form of a triode is still widely used for communications and radar purposes and noise temperatures of about 1,000° K may be expected. At higher frequencies, however, the triode becomes more noisy and less efficient as an amplifier, so that alternative means must be employed.

Until a few years ago the silicon point contact crystal (reminiscent of the cat whisker of the early days of radio) was widely used as the input stage of the receiver, subsequent amplification being carried out at a lower frequency using thermionic valves. A receiver of this type operating at 3,000 Mc/s has a noise temperature of about 1,500° K. The travelling wave tube, invented during the Second World War but only brought into use as a low noise amplifier during the 1950's, has proved to be a marked advance on the silicon crystal and is now largely used in radar and microwave communications. A typical noise temperature at 3,000 Mc/s would be about 1,000° K.

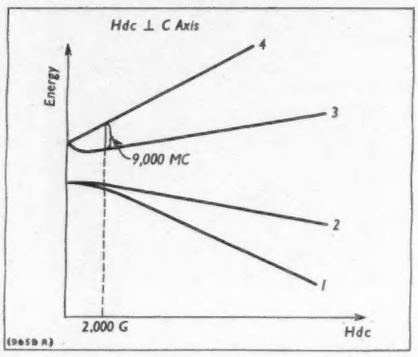


Fig. 1 Energy levels for chromium ions in ruby crystal lattice.

Further Improvement

A further marked improvement can now be expected through the use of parametric amplifiers, masers and possibly tunnel diodes although, up to the present, the low noise properties of the latter have been little exploited. The current work at Marconi's is paying particular attention to masers and parametric amplifiers.

The potential applications for masers are to be found in radio astronomy and in the field of satellite communications, where it should be possible to take advantage of the low sky temperature obtaining at high angles of elevation. For parametric amplifiers, the main applications would appear to be in ground communications, including microwave and tropospheric scatter links, and in radar. The noise temperatures from the maser and from the parametric amplifier at, say, 3,000 Mc/s may be expected to be something like 20° K and 150° K respectively. The improvement in performance of the parametric amplifier over that of the travelling wave tube makes it attractive for many purposes, but the increased cost and the technological difficulties involved in the use of the maser make its application less likely except in those cases where it would involve a considerable expenditure to obtain equivalent performance by an alternative means. Satellite communication is one field in which this is likely to apply, since a less sensitive receiver on the ground would mean a larger transmitter and therefore a heavier pay load in the satellite.

Solid State Maser

The operation of a maser device can only be explained in terms of the properties of atomic and molecular particles, and their interaction with electromagnetic waves, based in turn on the principles of quantum mechanics. The properties and interactions relevant to the maser are summed up under two headings.

(i) Atomic and molecular particles tend to exist naturally at discrete energy evels.

(ii) They can jump from one energy level to another under the influence of an electromagnetic wave of the right frequency. In the process they give up to the wave, or absorb from it, a discrete quantum of energy, depending on whether they dropped to a lower level or were lifted up.

The last statement contains the germ of the maser principle. All that must be done is to arrange for a great number of particles to exist at a higher energy level and to expose them to the stimulating influence of an electromagnetic wave, when they will drop to a lower energy level giving up quanta of electromagnetic power to the wave, and thus amplifying it. To achieve the interaction, the gap between the energy levels of the particles must be related to the frequency of the wave by the equation

$$\Delta E = hf$$

where $h(= 6{,}6 \times 10^{-34}$ joule-sec) is Planck's constant.

To realise a maser, particles that occupy energy levels separated by amounts proportional to a microwave frequency (10^{10} c/s) according to the equation above must be found. Secondly, favourable conditions must be arranged for the particles to interact with microwave signals and amplify them. Unfortunately such conditions are not found to exist naturally.

Paramagnetic ions provide energy levels suitable for use in solid state masers. The ions are included as trace impurities in host crystals which themselves are non-magnetic. The ion used most successfully so far is chromium, Cr^{+++}, diluted by the alumina (Al_2O_3) lattice, resulting in a pink ruby crystal. The energy level scheme provided by this substance is shown in Fig. 1 as a function of the dc magnetic field applied to the crystal in a definite direction relative to the crystal axis. The vertical axis of energy should be visualised as being calibrated in terms of frequencies. The same ion can also be embedded in a different crystal lattice—a complex cyanide lattice. The chromium ion should be visualised as replacing some of the aluminium atoms in the alumina structure and some of the cobalt atoms in the cyanide structure.

The following is a simplified explanation of how the four energy levels are set up when the paramagnetic substance is immersed in a magnetic field.

The paramagnetic ions are in effect minute atomic magnets which assume a definite potential energy when placed in a magnetic field. This energy is a function of both the magnetic field and the relative orientation of field and magnetic moment of ion. However, there is a basic difference between a macroscopic magnet and

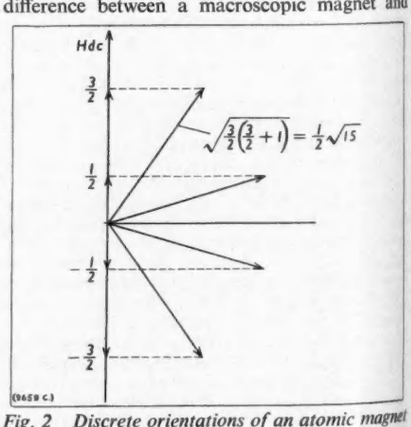


Fig. 2 Discrete orientations of an atomic magnet of quantum number $\frac{3}{2}$ in an applied magnetic field.

Research Report

on the work of the

Marconi Research Establishment
Great Baddow, Essex.

Director

E. EASTWOOD, Ph.D., M.Sc., M.I.E.E.

Deputy Director

G. D. SPEAKE, M.A. (Cantab.)

an atomic magnet. The former can be placed at any angle relative to the field, but the latter can only assume a finite number of discrete directions when a field is applied to it. The chromium ion is known to assume four directions in a magnetic field and therefore will exhibit four energy levels that vary with the applied field. The four possible orientations of the magnetic moment relative to the applied field are shown schematically in Fig. 2. The projections of the moment in the direction of the field can be characterised by the quantum numbers

$$\frac{3}{2}, \frac{1}{2}, -\frac{1}{2}, -\frac{3}{2}.$$

Under natural or equilibrium conditions the paramagnetic ions are distributed among the levels according to the Maxwell-Boltzmann exponential law shown in Fig. 3. The higher levels have smaller populations than lower levels.

To see what happens when a microwave signal is applied between levels E_2 and E_3 it is necessary to bear in mind that the *probability of ions jumping up or down under its influence is the same.* Hence, under natural conditions, more ions will perform transitions from level E_2 to level E_1 than vice versa, and a net absorption of microwave power will be observed. To achieve amplification, the natural state of affairs must be upset and somehow arranged for an excess of ions to be available in level E_3. This is accomplished by applying a strong microwave signal of the right frequency to cause transitions between levels E_1 and E_3. This intense wave will tend to "pump" ions from level E_1 to E_3, leaving E_2 unaffected, until E_3 has a more numerous population than E_2. A weak signal of frequency f_{23} will now be amplified.

The phenomena described above will only take place if the paramagnetic crystal is cooled to a very low temperature. For this reason masers are usually operated in a bath of liquid helium. (4·2° K at 760 mm Hg). Otherwise the favourable population distribution could not be realised because rapid relaxation processes would frustrate the work of the pump radiation.

Marconi Developments

To make a maser amplifier, a paramagnetic crystal is placed in a microwave cavity or a slow wave structure, resulting in a cavity maser or a travelling wave maser. In both cases provision is made to apply pump power, and a weak signal to be amplified; as shown in Fig. 4. It is clear from the diagrams that a maser set-up is complicated, especially if it is remembered that it is only the first stage of a sensitive receiver. Further complications arise when attempts are made to install it in conjunction with a large fully steerable aerial. For these reasons the use of a maser will only be justified in special circumstances in which its extremely low noise figure can be put to full use, and worthwhile economics on the transmitter side of a communication or radar system can be effected.

In 1958 it was clear that a solid state maser operated at liquid helium temperatures would become a revolutionary device in the hands of receiver designers. It was at this stage and for these reasons that work on maser techniques was initiated at the Marconi Research Laboratories.

It took some time before the requisite laboratory facilities were procured and assembled. In particular equipment to experiment at liquid helium temperatures had to be provided, and its use learned by the technical staff concerned with the project. Paramagnetic crystals (cyanides) were grown, and electronic equipment to test the maser was prepared.

The extremely low temperatures at which the maser must be operated are maintained by keeping the cavity or slow wave structure in a bath of liquid helium while the latter boils. The National Physical Laboratory have had in operation a helium liquifier for some years and they run a scheme whereby liquid helium can be obtained from them for research purposes. Special double Dewar's vessels must be used to transport the highly volatile liquid, and after it has boiled off in the course of an experiment, the gas must be collected, compressed into high pressure storage cylinders and returned for re-liquification.

After facilities to carry out these complicated operations were laid on, and the staff concerned acquainted themselves with the principles of this novel technique, systematic experiments were begun. The initial objective was to operate cavity masers at S-band (2,800 mc/s) and X-band (9,400 Mc/s) using cyanide and ruby crystals. The first cyanide maser was operated in summer 1960 (fs = 2,800 Mc/s, fp = 9,400 Mc/s), and then in quick succession three ruby masers were realised: (1) fs = 2,800 Mc/s, fp = 27,000 Mc/s; (2) fs = 9,400 Mc/s, fp = 27,000 Mc/s; (3) fs = 2,800 Mc/s, fp = 9,400 Mc/s.

All the time, it was intended to gain research experience rather than to develop a finished device ready for installation, particularly since it has become clear that cavity masers will be of very limited use. The research effort has led to the development of a simplified and accurate method of measuring the parameters of one-port resonant devices, of which the cavity maser is a typical example.

The work outlined above came to a close towards the end of 1960 and attention has shifted towards travelling wave masers and the investigation of paramagnetic relaxation processes. These processes are fundamental to the operation of maser devices. They pose problems which will be the subject of research for quite some time to come. Another line of research is provided by the need to find new materials which may facilitate the design and operation of masers or give rise to novel types.

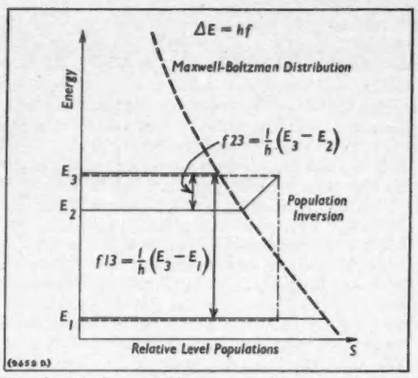


Fig. 3 Under equilibrium conditions, paramagnetic ions are distributed among the levels according to the Maxwell-Boltzmann exponential law.

The travelling wave maser promises to be of great use in connection with satellite communication systems and it is with this end in view that its development is being pressed in the Marconi laboratories.

In addition to their work on masers, the Marconi laboratories have developed several parametric amplifier devices. One of these, developed at the Communications Laboratory, is a "single-port" type which is to be used for tropospheric scatter link working at about 900 Mc/s. Work is also in hand on a wide-band travelling-wave parametric amplifier.

Optical Maser

The maser principle is of great importance not so much because it gives rise to a low noise amplifier at microwave frequencies, but because it makes possible the generation of coherent electromagnetic waves at infrared and optical frequencies. In this form it constitutes an altogether new phenomenon since coherent signals were not available at these short wavelengths until now.

A two-fold significance can be discerned in this discovery at present. In the first place the availability of coherent waves at these frequencies will enable physicists to carry out altogether novel experiments which in turn may result in new discoveries. On the other hand it may be possible to process these waves so that they can be made to carry information just as coherent waves at lower frequencies do. Viewing the situation from this angle, it may be concluded that the maser will become a vehicle for the exploration of yet another region of the electromagnetic spectrum; in a similar way to that provided by the klystron and magnetron, which helped to utilise the centimetric region for purposes of radar and communications.

Adopting now a different point of view, the advent of the maser means that a new electronic technology will be developed based on the principles of quantum mechanics. Some people already call it *quantum electronics.*

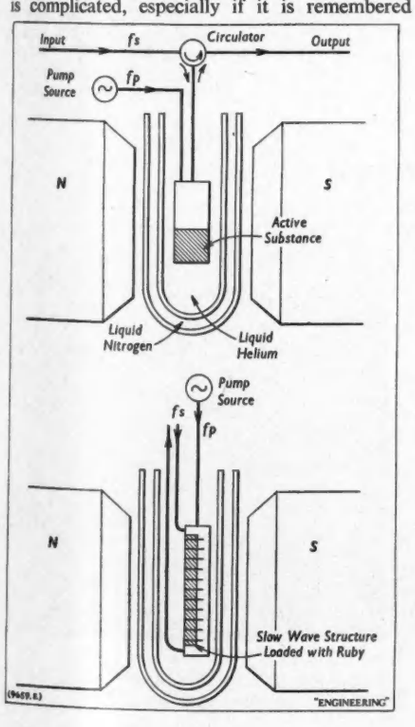


Fig. 4 (left) Schematic diagram of cavity (top) and travelling - wave masers.

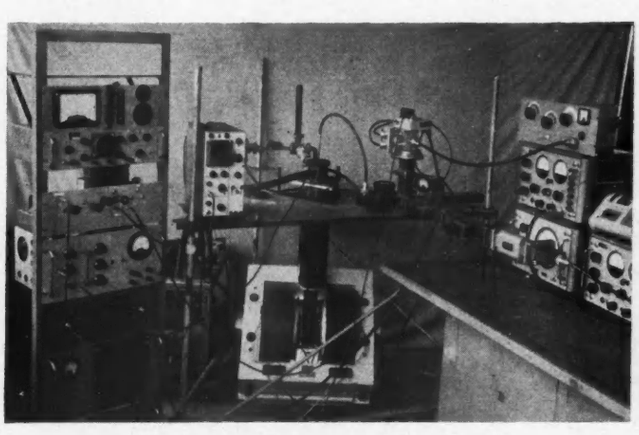


Fig. 5 (Right) Emphasis is being placed on travelling-wave masers and on investigations of paramagnetic relaxation processes.

Locating Fires in Large Buildings

The location of fires in a big building can often consume valuable time which could otherwise be spent in dealing with the trouble. At the BBC's Television Centre at White City, London, an extensive fire alarm system has been installed which will give coverage to all departments and buildings and will immediately indicate, in a central control room, the source of the fire.

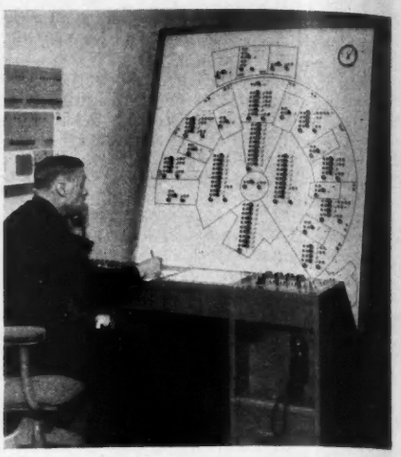
Focal point of the alarm system—which was designed and installed by Standard Telephones and Cables Limited, Connaught House, Aldwych, London, WC2—is the Fire Control Room, where an indicator board is manned continuously. The indicator board (shown in the illustration) comprises a combined site plan, a four-key cordless telephone switchboard and a " missing key " alarm panel. Three telephone handsets provide means of answering fire calls, calling firemen and for a normal extension.

The vertical panel of the alarm board gives a plan of the Television Centre and is divided into sections. Lamps on this board indicate the various floors within these sections, the location of rate-of-rise alarms, CO_2 alarms and sprinkler alarms. Floor alarms operate when a fire call originates from any telephone on that particular floor. Rate-of-rise alarms indicate any sudden increase in temperature and the CO_2 alarms operate when a fire has actually started and carbon dioxide is being released to blanket the flames. Sprinkler alarms will operate when the rise of temperature sets off the water sprinklers. Each lamp on the broad is associated with a buzzer unit so that both visual and audible alarms are given simultaneously.

In the event of an alarm, the duty fireman may from the control desk ring any floor bells in a selected area or throughout the whole of the Centre.

Fire calls may be traced from any telephone connected to the PBX—also supplied by STC—by dialling 666. The call is indicated on the site indicator console by two lamps which indicate the area from which the call came. These lamps remain alight whether or not the caller clears immediately. Audible signals continue until the " fire call answering " telephone handset is removed from the switch hook. Lifting the handset cancels the audible signal but does not prevent later calls from the same floor giving an audible signal. Four simultaneous calls may be taken and held by throwing a key associated with each line.

When a key is removed from the hydrant keys, a microswitch is operated and a lamp lit to indicate which key is missing.



The source of any fire in the Television Centre is immediately recorded in the Fire Control Room. The vertical panel of the alarm board giving a plan outline of the Television Centre can be seen.

Towards Automatic Aircraft Landings

KLM Royal Dutch Airlines predict that within approximately eight years, fully automatic landings in civil aircraft will be a normal routine.

The first trial installation of Para-Visual Director (PVD) equipment in a commercial airliner is to be carried out shortly in a Douglas DC8 belonging to KLM. The equipment, which is made by Smiths Aviation Division, Kelvin House, Empire Way, Wembley, Middlesex, will be installed later in the year by BOAC in a Boeing 707, by SAS in a DC8 and by the Boeing Airplane Company in a 707. BEA, who have already specified pilot and co-pilot PVD displays as an integral part of the Smiths automatic flight control and instrumentation system for the DH121 Trident, have for some time been experimenting with a single PVD unit as a collective pitch director in one of their helicopters.

At present, commercial aircraft use the Instrument Landing System (ILS) when visibility is poor. In this system, the correct flight path is indicated by an instrument using radio signals beamed from the ground. The pilot has to watch this instrument and at the same time he and his co-pilot must be looking ahead for the runway and they must decide the moment to switch from instrument to visual flying. With the PVD they can look ahead all the time yet still have full instrument control for their aircraft.

The KLM DC8 is to have azimuth and pitch displays for both pilot positions, totalling six units, together with a pilot's controller amplifier to drive the displays. This amplifier will be coupled to the aircraft's existing flight system, and will use computed ILS director signals derived from the flight director computer.

The PVD consists of three small built-in glass bars which are installed in duplicate in the cockpit around the two pilot seats. This is done in such a way that the three bars are continuously within the field of vision of the two pilots. Each indication of the instrument is so conspicuous that it cannot be overlooked.

In the three bars there are alternate white and black spirals. One bar is placed in a horizontal position above the instrument panel in front of the pilot, thus lying in the bottom field of vision. The other two bars are at the same level on the right and left of the pilot so that they form an angle with the central bar. If the plane deviates too much to the left the black rings on the front horizontal bar move to the right, indicating that a correction to the right is necessary. If the rings of the side bars move forward, the pilot knows that he is above the glide path and must make a downward correction. If the black rings in all three bars remain steady, the plane is exactly on course.

KLM emphasise that the installation of PVD will be for trial purposes and it will be used for training flights only. The DC8, in which the PVD will be installed is at present on route service, but it will be grounded during March for KLM to do the installation. A three day period of crew training in PVD flying is scheduled.

Sliding Roofs for Railway Freight Wagons

Sliding roofs for railway wagons offer many advantages. They replace tarpaulins which are expensive to maintain and are awkward to handle, they are completely waterproof and they eliminate pilfering.

Rubery, Owen and Company Limited of Darlaston, Staffs., who are the sole licensees in the UK to MacGregor and Company (Cargo Handling) Limited of 5 Camomile Street, London, EC3, have produced prototypes of the MacGregor sliding roof and these have been subjected to trials with a view to their introduction on British Railways. Orders for 100 covers have now been placed for fitting to new wagons and 20 for fitting to existing stock.

The roof is usually in four sections. When closed the ribbed sections forming the cover assembly rest upon rollers travelling along a longitudinal runway on the top ledge of the wagon and upon an intermediate push-roller on the adjacent section.

Movement of the roof is by a chain mechanism and is known as the single-pull bascule system. Operation is by one of four handles of which the upper pair may be operated from platform height and the lower pair from the ground. Handles are on both sides.

To open the cover—which takes about one minute—the locking lever, which has provision for safe fastening, is first released and the handle turned in a clockwise direction. An endless chain on each side of the cover passes over a winch mechanism operated by the handle, the chain being attached to the sections.

During opening, the endless chain draws the first section along so that it pushes the group by the intermediate rollers. Each section has a further set of rollers which engage in ramps and tilt the section into the vertical position as the storage compartment at the end is reached. The magazine holding the opened sections has a slight reverse ramp on the roller track and, consequently, these sections are self-parking when in the vertical position, and close together without effort from the operator.

Closing is by anti-clockwise turning of the handle, the sections connected by the chain successively pulling each other into position. The covers can be locked and sealed. Ventilation is provided through the overlaps.

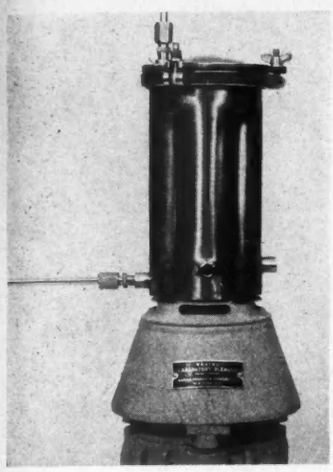
Sliding-top railway wagons give complete protection and ample ventilation to goods in transit.

Laboratory Unit Gives Safe Blending

When blending infected animal and human tissues in a blender running from 8,000 to 16,000 rpm in the US Army Chemical Research Station, it was discovered that the operators and others in the immediate vicinity fell victims of the diseases affecting the tissues.

It was found that ordinary blenders created a local atmosphere containing invisible particles of the diseased tissues. The Waring Products Corporation—a subsidary of the Dynamics Corporation of America—set to work and produce a completely gas-tight mixing chamber which has no leakages at any point.

Known as the Waring Aseptic Dispersall Blendor Model AS-1 the blender is marketed in



Aseptic blender mounted on explosion proof motor.

the UK by Winston Electronics Limited, Shepperton, Middlesex, and fits on to the standard 700S Waring Blendor base. The lid is rendered gas-tight by three thumbscrew clamps which bear down on an O-ring gasket.

The most difficult problem was to prevent the materials contaminating the bearing in the bottom-driven agitator assembly which drives the mixer blades. This was overcome by a construction that eliminates either the upper or lower bearings of the drive acting as a fluid seal against any ingredients being blended. Teflon bearings are used throughout the " standpipe " leakproof agitator.

Continuous flow blending is possible by using the inlet and outlet fitting provided. Ingredients may be drawn off hypodermically or by vacuum through the aspirator tube built into the lid. For cooling and heating purposes the base of the container is jacketed. All parts of the container are in 18/8 stainless steel and every part likely to come in contact with the contents is both corrosion proof and biologically inert.

High-Efficiency Low-Cost Precipitator

Anxious to encourage ideas in the quarrying industry, Hillhead Hughes Company Limited of Buxton, Derbyshire, agreed to experiment at a Lancashire limestone quarry with a precipitator of a new design.

The precipitator has a dual purpose: to collect dust from limestone crushers, conveyors and screens, and to clean exhaust gases from two limestone dryers, fired by pitch creosote, on the tarmacadam plant. Because of these two requirements, the precipitator was constructed in two independent halves, each with its own static HT rectifier set, inlet and outlet ducting, fan and stack.

The makers, Simon-Carves Limited, Precipitator Division, George Street Parade, Birmingham 3, say that in an attempt to reduce capital cost while maintaining high-efficiency collection, an economical arrangement of electrodes was tried out. They claim that the design brings high-efficiency dust collection within the reach of many would-be users who hitherto have been discouraged by capital costs of precipitators. Costs work out to about 10*s* per cu ft per min on this type of dust. Power consumption is in the region of one sixth kW per 1,000 cu. ft per min and the pressure loss through the precipitator is less than $\frac{1}{4}$ in wg.

Under acceptance test conditions the precipitator's efficiency exceeded 99 per cent. One factor which is of value at the Lancashire quarry is the market value of the recovered dust, which helps to offset costs. Another factor is that operatives enjoy improved working conditions and the surrounding buildings need less maintenance.

Eliminating Fire Risks During Petrol Loading

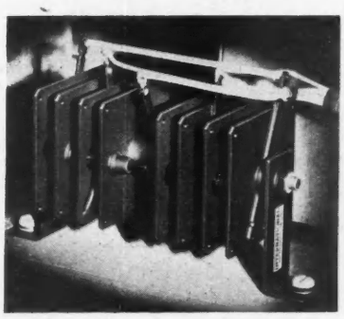
Static electricity is always a real danger where road petrol tankers are being filled or emptied. Under the Petroleum Spirit (Conveyance by Road) Regulations of 1957, the accumulation of a dangerous static charge must be prevented. To do this, the vehicle and loading arm must be effectively earthed.

What the makers call an intrinsically safe transformer/relay unit has been produced by the GEC Limited, Magnet House, Kingsway, London, WC2. An installation using these units as earth proving equipment, is in operation at the Esso Petroleum Company's bulk plant at Hythe. Here each bay is equipped with its own unit mounted on the gantry structure.

Two trailing leads are used in this particular system, one is at earth potential and the other insulated from earth. The circuit is arranged so that when both leads are connected to the metal structure of the road tanker, a circulating current flows, operating the relay which in turn provides a supply to the electrical side of an air operated valve. Remote indication of the operation of the valve is simultaneously given in the plant control room. By this interlocking arrangement the petrol cannot flow until the operator has properly earthed the vehicle.

Medium Power Silicon Stacks

Medium power silicon stacks with efficiencies of up to 98 per cent are being offered in a new range by the International Rectifier Company (Great Britain) Limited, Hurst Green, Oxted, Surrey. The range is designed to cover the



Stacks with high output to size ratio.

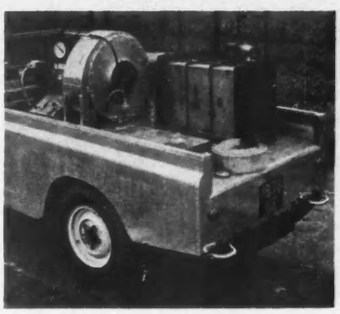
most commonly met outputs for power supplies in such equipment as power amplifiers, radio transmission gear and computer power packs. The high efficiencies are said to reduce the heating problem.

Stacks are available in single phase half wave, single phase bridge and three phase bridge configurations. Their high output to size ratio makes them easily interchangeable in existing equipment and reduces space requirements in new designs to a minimum. All assemblies are robustly constructed with " plate lock " fins and terminals, open ended mounting slots and colour coded terminals. Full tropical finish is applied to every stack.

Aircraft Engines Started by Steam

Airline operators are continually looking for equipment which will reduce the cost of starting aircraft engines. To meet these demands, and to provide a rugged, reliable self-propelled ground unit capable of starting the largest of turbine engines, a steam generating unit mounted on a Land Rover is now available.

Aircraft Equipment Sales, AEI Limited, Raglan Street, Coventry, are able to supply the



Steam generating unit for starting aircraft engines.

unit which is said to carry sufficient fuel for 50 starts; each start costing approximately 1*s* 6*d*. The system output can be adjusted to match different engine requirements and a typical starting time is about 15 seconds.

Steam generated in the flash evaporator is at similar temperature and pressure conditions to those at present used in low-pressure air starting systems. The steam is fed by hose to the aircraft starter turbine in the conventional manner for gas generators. Existing air starter turbines and hoses can be used with this system.

The engine of the Land Rover drives the water pump for the flash evaporator and also the fuel pumps and the air blower for the single combustion chamber which burns wide cut aviation gasoline to provide heat to evaporate the water.

Starting under the control of a ground operator does not take any power from the aircraft's electrical equipment, and when starting is under the control of the pilot, only the electrical power for valves installed in the aircraft is demanded.

Packaged Air Conditioners

A new range of packaged air conditioning units specifically designed for laboratories and costing, it is claimed, in some cases less than half comparable duty installations, has been introduced by Carlyle Air Conditioning and Refrigeration Limited, 1 King Street, London, SW1.

These laboratory conditioners have cooling capacities from 29,000 to 54,000 Btu per hour and have an electric heater battery and humidifier. Temperatures over a wide range of conditions can be obtained within close tolerances.

A separate discharge plenum with adjustable air deflectors for both horizontal and vertical distribution of the conditioned air is available with the unit. Ducting can be utilised if specific conditions warrant it, as the fans are specially designed for either application.

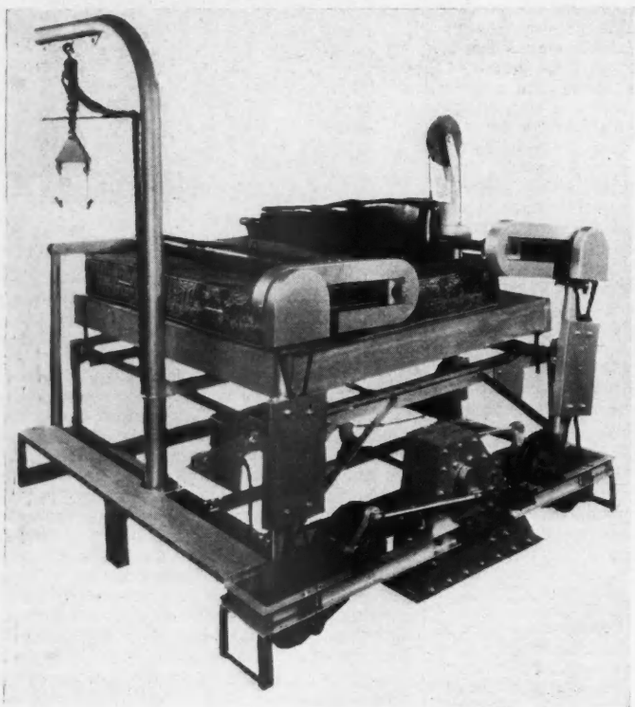
Each unit consists of an assembly of well balanced refrigeration, air handling, heating, humidifying and control-systems. They are packaged in a contemporary styled cabinet, ready for water and electrical service connections. The units are manufactured in two sizes.

Springs Under Test

MOST mattresses have a pretty hard life. Even the good sleeper turns some six times a night and there are those who are "restless" as well. The use of the edge of the bed as a seat by a 13 stone adult is no mean test of the mattress spring, and the idea possessed by most children that the bed is a domestic form of trampoline imposes loads on the springs never envisaged by the makers.

Mattresses are expected to stand up to years of this sort of use without developing that disease known as "gone in the middle." So that years of normal use can be imposed in hours, machines have been developed to roll and bounce and stamp —10 years' wear is simulated in 30 hours in one machine.

Tess and Tommy Tester are the two dummies in the machine illustrated, which was designed by P. Fanghanel and Company Limited, 50 Holborn Viaduct, London, EC1, and is used by Rest Assured Limited. Each shaped figure weighs 12 stone and rolls across the bed 12 times a minute. They are driven from a ¼ hp motor through a mechanism that applies a torque to the central shaft of the figure so that a true rolling motion is produced, closely imitating the action of a sleeping human using hips, shoulders and elbows as levers. It is particularly claimed that the rolling motion produced is free from drag and imposes only correct stressing on the covers.



Two rolling dummies, each weighing 12 stone, test the strength of a mattress by imposing the equivalent of 10 years wear in 30 hours. In addition a 177 lb dummy is lowered to "sit" on the edge to test the strength of that part.

Mattresses can be tested on a hard foundation as illustrated or on a sprung base or divan. The machine manufacturers say that tests have shown very clearly that a mattress lasts much longer when on a properly sprung base than on a hard table or a "chicken-wire" type of bed frame. Provision is also made on this machine for testing the edge construction of the mattress by lowering a freely suspended weight of 177 lb, realistically shaped to the human form, so that it "sits" on the edge. As nearly everybody sits on the edge of the bed twice a day to put their shoes and stockings on and later to take them off again, ten hours running in the machine is about equivalent to 10 years of use. To withstand this treatment the edge springs of a mattress should be stronger than those in the centre.

A machine working on a different plan is "Alec" (Accelerated Load Evaluation Computer), used by Vi-Spring Limited for their testing. Tess and Tommy roll but Alec stamps—with eight heavy pistons producing a total static weight of 22 stone. Alec was developed from the results of a survey carried out by the University of Colgate, New York, from which was formulated the amount of wear given to a mattress both by the reflex movements in sleep and the deliberate movements during normal consciousness. To speed up the tests one complete cycle of piston movement taking 74·6 sec corresponds to 20·45 hours normal use.

Alec's pistons are arranged in four pairs along the length of the mattress, and the mechanism causes each pair to traverse both longitudinally and transversely so that the whole area is covered. The pistons rise and fall according to a chosen sequence and at one period all are down and at another all are up so that the material can recover and the recovery be observed. The actual load applied to the mattress is greater than the static weight of the pistons due to the dynamic forces involved, and is claimed to be far more severe than would normally be encountered in practice.

The machine is designed to operate without attention and has indicator lights to show the piston movements. Pressure gauges and revolution counters are also included and there is a terminal scale of "wear in years," which is in fact the sum total of the various operations carried out during testing.

Two British Standards are particularly concerned with mattresses. BS 1877, which runs to nine parts, and BS 3173. Part I of BS 1877 deals with spring interior mattresses, and parts 2 to 8 with other types. Part 9 is concerned with upholstered wood framed bases and divan type bases. For the mattresses, maximum and minimum dimensions are specified and requirements as to type, quality, and quantity of filling materials, quality of coverings, method of manufacture, making up, tufting and marking are also included. BS 3173 deals with non-pocketed or open type spring units, and is interrelated with BS 1877 Part 1 where such units are used as the base for mattresses made to that standard. Size and material for the springs are specified and methods and types of apparatus for testing described.

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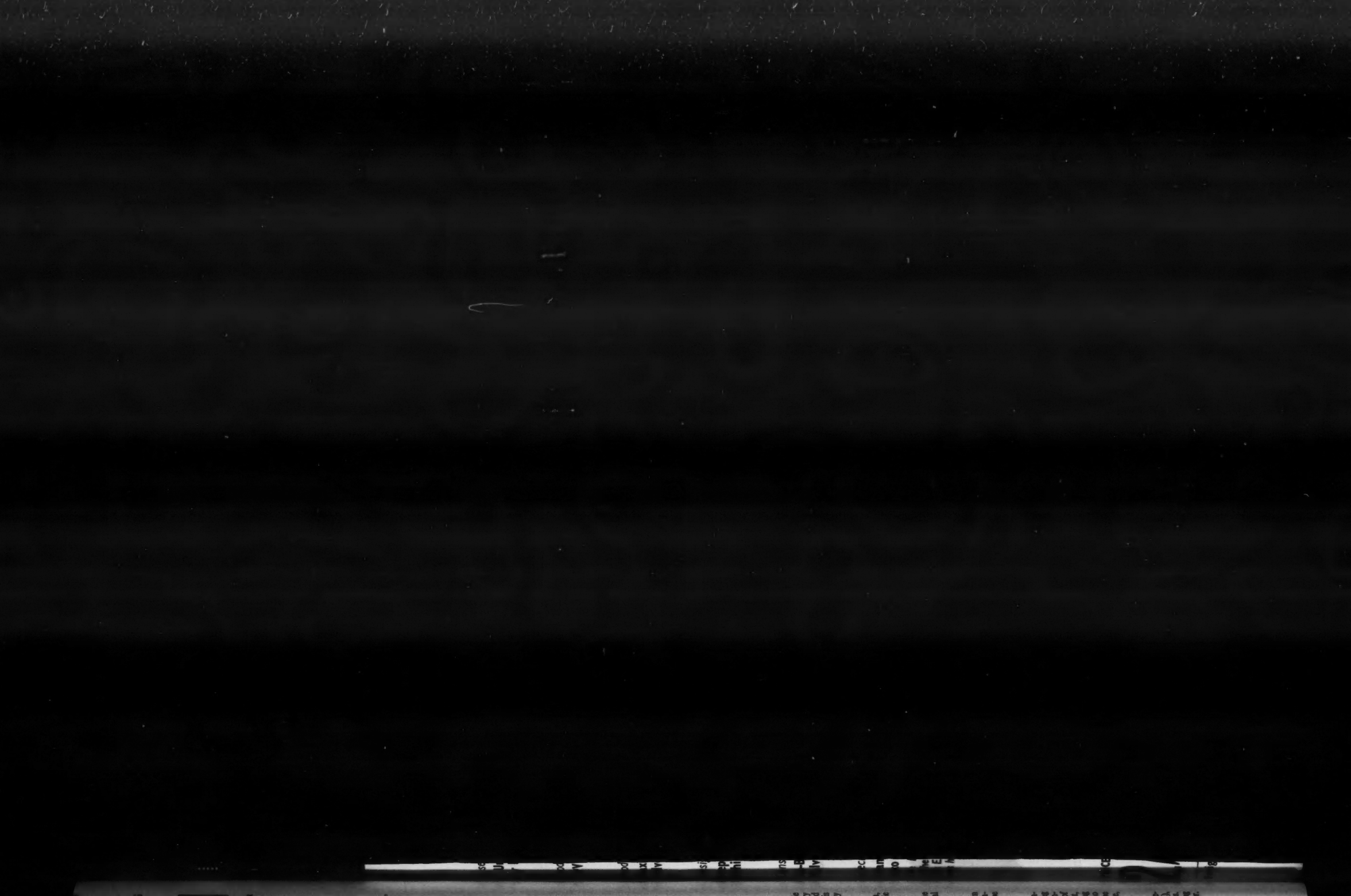
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